



THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT

Specifications | Devis

Project Name Nom du projet :	Construct New Workshop
DND Project File :	50047845
DCC Project File :	
Drawing Number Numéro du projet :	K-B35-2508/3
Date Date :	
Location Emplacement :	McNaughton
	Address Adresse
	City Ville
	ON
	Province Province
Project Manager Chargé de projet :	 GUILBEAU, CHRISTOPHER 069 2026.05.28 10:47:59 -04'00'
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K-B35-2508/3

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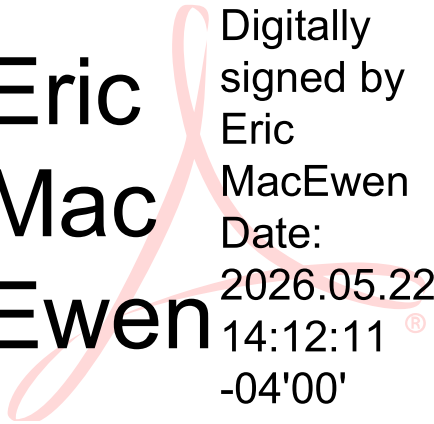
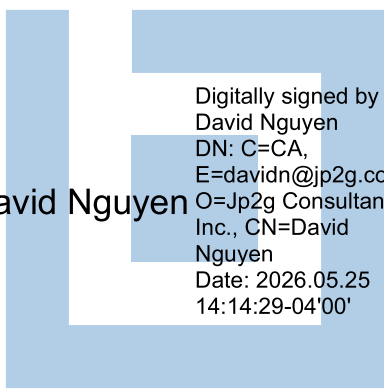
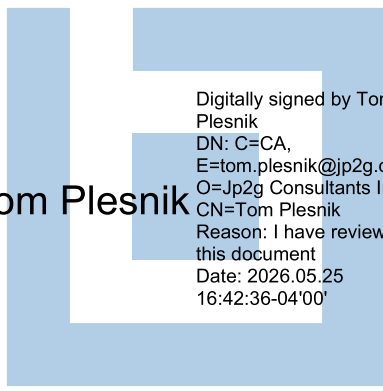
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Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13 – Selective Site Demolition.

1.2 SCOPE OF WORK

- .1 Work under this Contract covers the supply of all labour, materials and equipment required to carry out Construction in accordance with the contract documents. Work includes but is not limited to the following:
 - .1 The project address is Building 0049-B082, McNaughton Barracks, CFB Kingston, ON.
 - .2 Replacement of the electrical service entrance and provision of new padmount transformer and main distribution board.
 - .3 New standby generating set and automatic transfer switch.
 - .4 New building power distribution system.
 - .5 New underground trenching and ductbank.
 - .6 New interior lighting, lighting controls and exterior building mounted exterior lighting.
 - .7 New fire alarm system system.
 - .8 New voice/data distribution.
 - .9 Demolition and removal of existing electrical and mechanical systems.
 - .10 New pre-action sprinkler system and IT room clean agent suppression system.
 - .11 New HVAC and plumbing systems including new incoming water entry line.
 - .12 New DDC building automation system.
 - .13 Building renovations including new Electrical and Water Entry rooms, Conference/Meeting room, Kitchen/Lunchroom, CAD Work area and IT room. New windows, exterior doors, floor topping and floor coverings.
 - .14 Removal of existing overhead doors and closure of overhead door openings.
 - .15 New 2-ply membrane roof with rain gutter and downspout.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the furnishing of all labour, materials and equipment required for general construction and renovation as described in section 1.2 above, located at Building 0049-B082, McNaughton Barracks, CFB Kingston, ON.

1.4 CODES

- .1 Perform work in accordance with National Building Code of Canada (NBC), Ministry of Labour guidelines and regulations, applicable codes and standards and any other National Defence standard procedures that may be specified, (all latest editions). In any case of conflict or discrepancy, the more stringent requirement shall apply.
- .2 Meet or exceed requirements of:

- .1 contract documents,
- .2 specified standards, codes and referenced documents.
- .3 all of the above documents are latest issue, regardless of data shown in the specification.

1.5 DEFINITIONS

- .1 DCC Representative is Defence Construction Canada Ltd. DCC, as referenced in DCC General Conditions. DCC is the tendering agency and the Coordinator for the projects. DCC is the sole project authority representing National Defence and the Designer of Record for the project, during and after tender award.
 - .1 DCC Representative is the sole project authority. The Designer of Record is to have the DCC Representative approval for making any changes to the design or specification.
 - .2 The Contractor shall cooperate fully with the DCC Representative order that the DCC Representative and the Designer of Record may properly review the progress of the work during its execution.

1.6 SITE CONDITIONS AND INQUIRIES AT TENDER

- .1 It is highly recommended that Contractors should attend the site visit where possible to familiarize themselves with existing conditions and project intent during the tender. Bidders site briefing, if conducted, is not comprehensive and is not a substitute for a thorough review of the tender package by the Contractor.

1.7 SETTING OUT OF WORK

- .1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .2 Provide everything needed to lay out and construct work.
- .3 Supply any devices and or templates required to facilitate DCC Representative or authorized testing agencies inspection of work.
- .4 Location of non-base controlled services are the responsibility of the contractor to obtain. These are typically natural gas, telephone, cable and local utility controlled electrical. Base will locate services as follows: Base controlled electrical, sewer, steam, water and communications.
- .5 Saturday and Sunday work or work on specified Statutory Holidays is NOT permitted unless approved by the DCC Representative.
- .6 Contractor is to provide a qualified and competent superintendent and is to be present at the job site when work is being performed.

1.8 WORK SEQUENCE

- .1 Building will be unoccupied during the construction period.
- .2 Co-ordinate Progress Schedule with DCC Representative.

- .3 Maintain fire access/control.

1.9 CONTRACTOR USE OF PREMISES

.1 Use of DND Property:

- .1 Contractor, sub-contractor(s) and all personnel of this contract shall not use any tools, equipment, materials, buildings, structures or any other or any other property owned, rented leased by the Department of Nation Defence (DND) unless authorized in writing by the DCC Representative.

.2 Contractor's Use of Site:

- .1 Use of site: exclusive and complete for execution of work, within the boundaries of the Project area of work, unless otherwise stated in writing by the DCC Representative.

.3 Co-ordinate use of premises under direction of DCC Representative.

.4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by DCC Representative.

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.10 OWNER FURNISHED ITEMS (AS NEEDED)

.1 Contractor Responsibilities:

- .1 Receive and unload products at site.
- .2 Inspect deliveries jointly with DCC Representative; record shortages, and damaged or defective items. Inform DCC Representative immediately in writing of condition of items received.
- .3 Handle products at site, including uncrating and storage.
- .4 Protect products from damage, and from exposure to elements.
- .5 Assemble, install, connect, adjust, and finish products.
- .6 Repair or replace items damaged by Contractor or subcontractor on site (under his control).

1.11 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendation for safety, assess and maintenance. Advise DCC Representative of conflicts and await clarification.

.3 Inform DCC Representative of impending installation and obtain their approval for actual location.

.4 Submit red line drawings to indicate relative position of various services and equipment.

1.12 CONCEALMENT

.1 Conceal pipes, duct and wiring in the floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.13 CUTTING AND PATCHING

.1 Cut and patch as required to make work fit. Refer to appropriate sections and details. Where no detail is given advise DCC Representative and wait for direction.

.2 Make cuts with clean, true, smooth edges.

.3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work or as indicated.

1.14 ADDITIONAL DRAWINGS

.1 DCC Representative may furnish additional drawings for clarification. These additional drawings have same meaning and intent as if they were included with plans referred to in Contract documents.

1.15 RELICS AND ANTIQUITIES

.1 Protect relics, antiquities, items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found during course of work.

.2 Give immediate notice to DCC Representative and await DCC Representative written instructions before proceeding with work in this area.

.3 Relics, antiquities and items of historical or scientific interest remain Crown property.

1.16 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible damage or disturbance to existing building areas to remain. Arrange with DCC Representative to facilitate execution of work.

1.17 EXISTING SERVICES

.1 Notify, DCC Representative of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give DCC Representative 5 working days notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by DCC Representative with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

- .3 Provide alternative routes for personnel, pedestrian and vehicular traffic.
- .4 Submit schedule to and obtain approval from DCC Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide temporary services when directed by DCC Representative to maintain critical building and tenant systems.
- .6 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .7 Where unknown services are encountered, immediately advise DCC Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, notify DCC Representative.
- .9 Record locations of maintained, re-routed and abandoned service lines on redline drawings.
- .10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.18 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.
 - .12 Utility locate sheets.

1.19 QUALITY ASSURANCE

- .1 The review of the work by the DCC Representative is to confirm adherence to the intent of the design. It does not release the Contractor from his responsibility for the proper execution of the work in accordance with the drawings and specifications and all governing regulations and good workmanship and established trade practices.
- .2 The sampling inspection of material installations by testing agencies will not release the Contractor from his responsibility for the thorough execution of the work in accordance with the

drawings and specifications and all governing regulations, good workmanship and established trade practices.

- .3 The intermittent site reviews and subsequent reports by the Designer of Records do not constitute thorough inspection, blanket approval or comprehensive deficiency findings of the installations performed by the Contractor. They are limited to what has been witnessed and to establish adherence to the intent of the design. The Contractor is responsible for the proper execution of the work in accordance with the drawings and specifications and all governing regulations, good workmanship and established trade practices.
- .4 The Contractor is responsible for securing timely written clarifications where the intent of the design may not be clear.

1.20 COST BREAKDOWN

- .1 Within 10 working days of award submit breakdown of Contract price in detail as directed by DCC Representative and aggregate contract price. Cost breakdown will be used as basis for progress payment.
- .2 Itemized separate line cost for each of the following general cost items as applicable.
 - .1 Performance and Payment Bonds.
 - .2 Field supervision and layout.
 - .3 Temporary Facilities and Controls.
- .3 Itemize separate line-item cost for work required by each Section of this Specification.

1.21 PROJECT MEETINGS

- .1 Hold construction project meetings at times and locations approved by DCC Representative.
 - .1 For bidding purposes, assume Project Meetings to be held bi-weekly.
- .2 DCC Representative will advise General Contractor of meetings. General shall be responsible for notifying sub-contractors and any other interested parties whose attendance is required.
- .3 DCC Representative will assume responsibility for recording and distributing minutes to all interested parties.

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 RELATED REQUIREMENTS

- .1 Section 01 32 16.19 – Construction Progress Project Schedules – Bar (GANTT) Chart
- .2 Section 01 35 15 – Industrial Security Contractor
- .3 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding as required, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with DCC Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security, in accordance with section 01 35 15 Industrial Security.
- .4 DCC Representative may, at their sole discretion assign sanitary facilities for use by Contractor's personnel. Keep facilities clean. For bidding purposes, assume that the Contractor provides sanitary facilities.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with DCC Representative to facilitate execution of work.

1.5 SPECIAL REQUIREMENTS

- .1 Carry out Work Monday to Friday from 07:00 to 17:00 hours, except when other hours are approved by DCC Representative. No work on statutory holidays unless approved by DCC Representative.
- .2 Interruptions and connections to the CFB Kingston Steam network will only be allowed during the period of June 1st to September 30th, unless directed otherwise by the DCC Representative.
- .3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

- .4 Keep within limits of work and avenues of ingress and egress.

1.6 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking 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 RELATED REQUIREMENTS

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by DCC Representative are specified under sections as applicable.

1.2 APPOINTMENT AND PAYMENT

- .1 DCC Representative will appoint and pay for services of testing laboratory except follows:
- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under supervision of DCC Representative.
 - .6 Additional tests specified in paragraph 1.02.2.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by DCC Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
- .1 Provide access to Work for inspection and testing.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify DCC Representative 3 working days minimum in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and accepted by DCC Representative.

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 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.

1.2 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 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 DCC Representative 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.
- .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.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 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.
- .2 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.
- .3 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 DCC Representative 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 DCC Representative, 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 Substantial Completion 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 DCC Representative, for purpose of network planning, scheduling, updating and progress monitoring.
 - .1 Approvals by DCC Representative 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, Substantial Completion and Final Certificate as defined times of completion are of essence of this contract.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative, within 21 days after the award of contract, Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to DCC Representative for approval; failure to comply with each required submission, may result in progress payment being withheld.
- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .6 Refer to article "Progress monitoring and reporting" of this specification Section for frequency of Project control system submittals.
- .7 Submit to DCC Representative Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting as in the following form.
 - .1 Electronic files in original scheduling software containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update. Master Plan Bar Chart.
 - .2 Construction Detail schedule Bar Chart.

- .3 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.
- .4 Criticality report listing activities and milestones with 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.
- .5 Progress report in early start sequence, listing for each trade, activities due to start, underway, or finished within two 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.

1.5 QUALITY ASSURANCE

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

1.6 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare and submit to DCC Representative construction Work Breakdown Structure (WBS) within 10 working days of Award of Contract date.
 - .1 Develop WBS through at least 5 levels: Project, stage, element, sub-element and work package.

1.7 PROJECT MILESTONES

- .1 Mandatory and recommended project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.
 - .1 Include stages/phasing here.

1.8 MASTER PLAN

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Plan (CPM logic diagram) and dependent Cash Flow Projection within 15 working days of finalizing Agreement to confirm validity or alternates of identified milestones.
 - .1 Master Plan will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by DCC Representative.
 - .2 DCC Representative will review and return revised baseline within 10 work days.
- .3 Reconcile revisions to Master Plan and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Plans will include:
 - .1 USB Drive 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 monthly and shown in both graphical and numerical form.

1.9 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within 15 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 3 months beginning from Award of Contract date with each activity duration approximately 15 days.
 - .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 Plan.
- .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 should 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 DCC Representative for review effects created by insertion of new Change Order.

1.10 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

- .1 Allow 5 work days for review by DCC Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to DCC Representative for review within 10 work days.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by DCC Representative.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.11 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 DCC Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel on site for effected activities or work package.
 - .2 Increase in materials and equipment.
 - .3 Additional work shifts.
- .4 Submit to DCC Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:
 - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
 - .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
 - .3 Other supporting evidence requested by DCC Representative.
 - .4 Do not assume approval of Contract extension prior to receipt of written approval from DCC Representative.
- .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 DCC Representative 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.

1.12 PROGRESS MONITORING AND REPORTING

- .1 On ongoing basis, Detail Schedule on job site must 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 DCC Representative 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 DCC Representative a copy 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 must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any 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 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .3 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days.
- .4 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .5 Milestone: significant event in project, usually completion of major deliverable.
- .6 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .7 Project Planning, Monitoring and Control System: overall system operated by DCC Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Ensure Project Schedules are practical and remains within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that Award of Contract, Interim Certificate and Final Certificate dates are identified on the schedule.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative within 10 working days of Award of Contract, a detailed Project Schedule, capable of identifying, scheduling, monitoring and reporting activities related to the progress of work. Provide sufficient detail and degree of control in the schedule to the approval of the DCC Representative and such that the needs and objectives of the Contract are met.

1.4 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule. Contractor to identify milestones on project schedule. Contractor to include identified milestones from Tender Documents on Project Schedule.

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Identification of work periods on a horizontal time scale, from date of award to completion. Indicated weekend or after hours work, if required.
 - .2 Submission date, review times for shop drawings, product data and samples.
 - .3 Anticipated progress of the work for each major activity by discipline. Duration of each task shall be a maximum of 10 days.
 - .4 Identification of the most critical activities throughout the course of the project.
 - .5 Major equipment/material deliveries.
 - .6 Backfill of any utilities.
 - .7 Planned shutdowns of existing systems for work requirements.
 - .8 Proposed dates(s) for commissioning, if required.
 - .9 Training for personnel on new systems.
 - .10 Submission of Redline Drawings, updated Record Drawings and Operations and Maintenance Manuals.
 - .11 Mobilization and demobilization.
- .3 DCC Representative will review schedule and return review copy with comments or request for clarifications within 10 business days after receipt.
- .4 Submit finalized schedule within 10 business days after return of review copy.

1.6 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on monthly basis reflecting activity changes and completions, as well as activities in progress.

1.7 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Submit progress update of activities against planned progress on a bi-weekly basis as requested by the DCC Representative. Progress update to reflect the next 2 weeks of work.
- .3 Weather related delays with their remedial measures will be discussed and negotiated.

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 RELATED REQUIREMENTS

- .1 **Precedence** - Division 1 sections take precedence over technical specifications in other Divisions of this project manual.

1.2 REFERENCES

- .1 Definitions:
 - .1 Contract Security Program (CSP) - A division of Public Services and Procurement Canada (PSPC), which developed the Contract Security Manual and helps industry to participate in Government of Canada and foreign government contracts. CSP provides security screening services needed for contractors before their employees can work with Protected and Classified information and assets.
 - .2 Company Security Officer (CSO) - The CSO is the organization's official point of contact with the CSP. The CSO is responsible for monitoring the organization's security profile, addressing security issues, and is accountable to the CSP and to the organization's designated Key Senior Official on all industrial security matters.
 - .3 Contractor CSO - The employee of the Contractor's company who is the CSO.
 - .4 Contract Security Manual (CSM) - The CSM is a ready and simple reference which tells Company Security Officers what they must know about Canadian government security standards and procedures and how to ensure that their organization meets these security requirements.
 - .5 Positive Control - Measures which guarantee that persons without appropriate clearance will not be left unattended to access the Department of National Defence/Canadian Armed Forces (DND/CAF) information, assets, resources, or locations.
 - .6 Request for Visit (RFV) - A form to be filled out by an individual who requires access to sensitive DND property, personnel, information, assets and resources because they must be security screened at the appropriate level before commencement of their duties.
 - .7 Restricted - Refers to a situation where authorized persons only, are allowed access to an area or information.
 - .8 Security Implementation Plan - A detailed document which outlines the company's strategy and process to meet contract security requirements.
 - .9 Security Requirements Check List (SRCL) - The SRCL is a Treasury Board Secretariat (TBS) form used to define the security requirements for a contract. The SRCL represents an evaluation of security threats and risks that may arise through the contracting process.
 - .10 Sensitive - Records that are sensitive contain information that can cause different degrees of injury to an individual, a company, or the country if the information were disclosed in an unauthorized manner.
- .2 Reference Sites:
 - .1 Defence Construction Canada (DCC)
 - .1 <https://www.dcc-cdc.gc.ca/industry/security-requirements>
 - .2 PSPC Contract Security Manual

.1 <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>

1.3 GENERAL

- .1 Security requirements must form part of the contract between DCC and industry when defined by a SRCL.
- .2 These security requirements apply but are not limited to:
 - .1 construction and material objects;
 - .2 contractual arrangements;
 - .3 professional service contracts;
 - .4 facility maintenance contracts; and
 - .5 environmental and UXO contracts.
- .3 A SRCL is a form that is used to define the security requirements associated with each contract. The SRCL ensures that the appropriate security clauses are identified so they may be incorporated into the contract, thereby legally binding the parties to meet the contract's security requirements. **The SRCL must accompany all contract documents including subcontracts that contain security requirements.**
- .4 If multiple levels of screening are required, a Security Classification Guide may have been provided along with the SRCL as a contractual document. This document will provide further information related to security requirements when dealing with multiple levels of clearances within the contract.

1.4 PRIVATE SECTOR ORGANIZATION SCREENING AND CLEARANCES

- .1 Companies who will need access to or who will retain controlled goods, protected or classified property, information, assets or resources must be cleared as follows:
 - .1 Companies must be cleared to safeguard the highest level of information and asset to be retained/accessed, meaning:
 - .1 Designated Organization Screening (DOS) is required for contracts involving access to information at the protected level and/or secure worksites (Reliability status);
 - .2 Facility Security Clearance (FSC) is required for contracts involving access to information at the protected and/or classified levels and/or secure worksites (Secret status);
 - .3 Document Safeguarding Capability (DSC) is required to work on protected and/or classified information at their own worksite; and
 - .4 Companies who will electronically process protected or classified information must have IT media clearance and processing capability commensurate with the security classification level of the information to be processed and must be cleared to the level commensurate with the information or asset to be accessed.

1.5 PERSONNEL SECURITY SCREENING

- .1 Individuals requiring access to information and/or site must have their personnel security screening completed prior to submitting an RFV. As a part of the screening process, it is now a requirement for individuals to undergo a law enforcement inquiry through the RCMP, for electronic finger printing. Please refer to PSPC website for more information.

- .2 Prior to Contract Award, personnel security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules to seek personnel security screenings as required by the contract.
 - .1 Reliability status processing is anticipated to take seven (7) business days per employee after a request has been properly submitted to CSP; and
 - .2 Secret clearance processing is anticipated to take seventy-five (75) business days per employee after a request has been properly submitted to CSP.

1.6 VISIT CLEARANCE REQUESTS (VCR) APPROVAL

- .1 All individuals (including subcontractors) who will have access to sensitive DND or CAF property, personnel, information, assets, and resources, must be security screened at the appropriate level before the commencement of their duties in relation to the contract.
- .2 Access to Operations Zones: security screening is not required for certain personnel if positive control of those individuals is maintained throughout their visit. Positive control measures must be outlined in the Security Implementation Plan. Positive control can be used for the following personnel:
 - .1 Logistics activities – material drop-off, waste removal, snow removal;
 - .2 Transit through an operations zone (no work); and
 - .3 Authorities having jurisdiction.
- .3 The VCR process verifies that those who are permitted access onto DND property have the required clearance level as outlined within the SRCL for the contract.

1.7 POST AWARD PROCESS OVERVIEW

- .1 The Contractor's CSO is provided a blank RFV form by the DCC Representative in order to obtain an approved VCR.
- .2 All employees of the successful bidder who will be accessing restricted sites or sensitive information during the execution of the contract require a VCR. The Contractor's CSO must forward the completed form to the DCC Representative for processing.
 - .1 The CSO of each company completing an RFV form must submit a picklist from the Online Industrial Security Services (OLISS) portal instead of filling in the details of each visitor on the form. Only the employees of the company who require access to the restricted site or sensitive information for that contract shall be listed on the picklist.
 - .2 If the Contractor intends to use Union Hall members, the CSO will request the Union Hall to provide the CSO with a separate picklist for all members to be used on the contract. Only the individuals of the Union Hall who require access to the site for that contract shall be listed on the picklist.
 - .3 The CSO of the company will input "SEE ATTACHED PICKLIST" when completing Particulars of Visitors.
- .3 It is the responsibility of the Prime Contractor to submit and receive an approved SRCL for each subcontract containing security requirements. This responsibility extends to all subcontracts held by subcontractors.
 - .1 Instructions on this process are in the CSM located at <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>

- .2 Prior to Contract Award, subcontract SRCL security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules for subcontract SRCL approvals as required by the contract.
 - .1 When a Private Sector Organization Screening (PSOS) is **not** required, contractors shall allow 45 business days (from the date on which a complete and correct subcontract SRCL is received by CSP) for approval of a subcontract SRCL by CSP.
 - .2 When a PSOS **is** required:
 - .1 For sub-contractors to be sponsored to the level of DOS, contractors shall allow for 50 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP; and
 - .2 For sub-contractors to be sponsored to the level of FSC (Secret), contractors shall allow 124 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP.
- .3 All security related pre-construction activities shall proceed immediately after award.
- .4 For subcontracts, the RFV shall not be submitted until after the subcontract SRCL has been approved and permission to award the contract is granted by CSP.
 - .1 Contractor to allow a minimum of 15 business days for VCR processing.
- .5 Personnel not meeting the required security clearances will not be allowed access to restricted sites or any sensitive information pertaining to the contract, except as permitted in 1.6.2.
- .6 Approved VCRs are valid for the duration of the contract **or** one year less one day, whichever is less. Extension to VCRs will need to be requested as required, again allowing a minimum of 15 business days for processing.

1.8 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Security Implementation Plan
 - .2 Approved subcontract SRCLs
 - .3 Completed Request for Visit forms for all personnel working under the contract
 - .4 Incident reports within (1) working day
 - .5 Submit other data, information and documentation upon request by the DCC Representative.

1.9 RESPONSIBILITY

- .1 It is the responsibility of the Contractor to have no security breaches while undertaking the work for this contract.

1.10 MEETINGS

- .1 Prior to commencement of work, the Contractor will attend a pre-commencement meeting conducted by the DCC Representative. Ensure, as minimum, attendance by Contractor's site superintendent.

- .1 The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
- .2 If requested by the DCC Representative, the Contractor's CSO will be required to participate in the pre-commencement meeting.
- .2 Conduct site specific security meetings as required to ensure the management of security is in accordance with the contract.
 - .1 Record and post minutes of all meetings as allowed by the security requirements of the contract.

1.11 SECURITY IMPLEMENTATION PLAN

- .1 Contractors are required to have in place a contract specific Security Implementation Plan that addresses the security requirements outlined in the contract.
- .2 Provide one copy of the Security Implementation Plan to the DCC Representative prior to the commencement of work.
- .3 At a minimum, the plan shall contain details addressing:
 - .1 CSO name and contact information;
 - .2 Schedule for subcontract SRCLs and RFVs;
 - .3 Site Access and Control Monitoring including verification that all people entering secure areas on site have approved VCRs in accordance with contractual security requirements, or any planned positive control measures;
 - .4 Security Education (i.e. Restrictions on photographs); and
 - .5 Security Incident Reporting.
- .4 The DCC Representative will coordinate review of the Security Implementation Plan by the DND Project Security Authority to be completed within 10 business days of receipt following which the DCC Representative shall confirm DND's acceptance or rejection with comments.

1.12 INCIDENT REPORTING

- .1 Investigate and report any security incidents immediately to the DCC Representative.
 - .1 Immediately provide a copy of the incident/investigation reports to the DCC Representative.
 - .2 Refer to Chapter 5 of the CSM <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html> for more information.
- .2 For the purpose of this contract, immediately notify the DCC Representative of incidents that involve a security breach from the identified clauses on the SRCL or an interruption to adjacent and/or integral infrastructure operations with potential loss implications.
- .3 In the investigation and reporting of incidents, the Contractor is required to respond in a timely fashion (within 5 working days) to correct the action that was deemed to have caused the incident and advise in writing on the action taken to prevent a re-occurrence of the incident.

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 RELATED REQUIREMENTS

- .1 Section 01 32 16.19 – Construction Progress Schedules – Bar (GANTT) Chart.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 01 78 00 – Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 This section specifies general requirements and procedures for contractor submissions of shop drawings, product data, samples, mock-ups and certificates to DCC Representative for review. Additional specific requirements for submissions are specified in individual sections of the specification.
- .2 Submit to DCC Representative 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.
- .3 Do not proceed with Work affected by submittal until review and acceptance by the DCC Representative.
- .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units converted values are acceptable.
- .6 Review submittals prior to submission to DCC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not dated and identified as to specific project will be returned without being examined and considered rejected.
- .7 Notify DCC Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .8 Verify field measurements and affected adjacent Work are co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by DCC Representative's or Designer of Record review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DCC Representative or Designer of Record review.
- .11 Submitted shop drawings that do not consider the time requirement for review and or the time required to order, manufacture and deliver does not constitute justification or grounds for requesting an alternate material that is readily available for the project. Contractor shall bear all costs associated to provide the acceptable product to deliver the project on schedule.

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

1.3 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 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 co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 10 working days for DCC Representative's review of each submission.
- .4 Make changes in shop drawings as DCC Representative may require, consistent with Contract Documents. When resubmitting, notify DCC Representative in writing of revisions other than those requested.
- .5 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project Title and Building Number.
 - .3 DND Drawing Number
 - .4 DND Project Number
 - .5 DCC Project Number
 - .6 Contractor's name and address.
 - .7 Identification and quantity of each shop drawing, product data and sample.
 - .8 Other pertinent data.
- .6 Submissions include:
 - .1 Date and revision dates.
 - .2 Project Title and Building Number.
 - .3 DND Drawing Number
 - .4 DND Project Number
 - .5 DCC Project Number
 - .6 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .7 Signature by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .8 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.

- .2 Layout, showing dimensions, including identified field dimensions, and clearances.
- .3 Setting or erection details.
- .4 Capacities.
- .5 Performance characteristics.
- .6 Standards.
- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.
- .7 After DCC Representative's review, distribute copies.
- .8 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as DCC Representative may reasonably request.
- .9 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by DCC Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .10 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by DCC Representative.
 - .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.
- .11 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by DCC Representative.
 - .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 project contract complete with project name.
- .12 Submit electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by DCC Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- .13 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by DCC Representative.
- .14 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

- .15 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by DCC Representative.
- .16 Delete information not applicable to project.
- .17 Supplement standard information to provide details applicable to project.
- .18 If upon review by DCC Representative, no errors or omissions are discovered or if only minor corrections are made, electronic acceptance copy 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.

1.4 SAMPLES

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to DCC Representative.
- .3 Notify DCC Representative 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 Make changes in samples which DCC Representative may require, consistent with Contract Documents.
- .6 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.
- .2 Reviewed and accepted mock-ups will become standard of workmanship and materials against which installed work will be verified.
- .3 Erect mock-ups at locations acceptable to DCC Representative.

1.6 PHOTOGRAPHIC DOCUMENTATION

- .1 When called for inspections submit electronic copy of colour digital photography in .jpg format, standard resolution and as directed by DCC Representative.
- .2 Project identification: name and number of project and date of exposure indicated.

1.7 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 CONSTRUCTION FIRE SAFETY

- .1 The Contractor shall provide construction fire safety in accordance with the National Fire Code of Canada.

1.2 FIRE DEPARTMENT BRIEFING

- .1 DCC Representative will co-ordinate arrangements for Pre-Commencement Meeting following contract award. Contractors will be briefed on Fire Safety by the Chief Fire Prevention Officer (CFPO) or his designated representative before work starts.

1.3 REPORTING FIRES

- .1 The Contractor shall inform the DCC Representative and CFPO of all fire incidents at the construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Call 911.
 - .3 Call DCC Representative & Chief Fire Inspector by contacting 613-541-5010 x 5795 / Cell: 613-484-8166
- .4 Person activating fire alarm pull station will remain at the front entrance to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and (must give municipal address) be prepared to verify location.

1.4 FIRE SAFETY PLAN

- .1 Submit fire safety for the construction site prior to commencement of construction work. The fire safety plan shall conform to the National Fire Code of Canada.
- .2 The fire safety plan shall be limited to the area of construction only. Fire safety plan shall contain building-specific details for planned system impairments. Contractor is not responsible for amending fire safety plans in existing buildings.
- .3 The fire safety plan shall be submitted to the DCC Representative for review by Chief Fire Inspector. Allow 10 working days for DND review. Any comments by CFB Kingston Chief Fire Inspector shall be implemented by the Contractor.
- .4 Post the fire safety plan at entrance to the construction site or near construction site's health and safety board.

- .5 The fire safety plan shall conform to the National Fire Code of Canada and shall contain, at minimum:
 - .1 Emergency procedures to be used in case of fire, including:
 - .1 Sounding the fire alarm;
 - .2 Notifying the fire department;
 - .3 Instructing occupants on procedures to be followed when fire alarm sounds;
 - .4 Evacuating occupants, including special provisions for persons requiring assistance; and
 - .5 Confining, controlling and extinguishing fires.
 - .2 The appointment and organization of designated supervisory staff to carry out fire safety duties.
 - .3 The training of supervisory staff and other occupants in their responsibilities for fire safety.
 - .4 Documents including diagrams, showing type, location and operation of building fire emergency systems.
 - .5 Holding of fire drills (where applicable).
 - .6 The control of fire hazards in the building.
 - .7 The inspection and maintenance of building facilities provided for the safety of occupants.

1.5 FIRE WARNING SYSTEM

- .1 A fire warning shall be provided to notify construction personnel of a fire emergency in the construction area.
- .2 The system used shall be capable of being heard throughout building.

1.6 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

- .1 Unless authorized by the DCC Representative and the CFPO, Fire protection and alarm system will not be:
 - .1 Obstructed.
 - .2 Shut-off.
 - .3 Left inactive at the end of working day or shift without prior written authorization from the CFPO
- .2 Do not use Fire hydrants, standpipes or hose systems for other than fire-fighting purposes unless authorized by the CFPO.

1.7 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Notify the DCC Representative and the CFPO 48 hours prior to shutting down any active fire protection system, including water supply, fire suppression, fire detection and life safety systems.

- .2 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, per the Contractor's fire safety plan a fire watch shall be required and provided by the Contractor.
- .3 The quantity of personnel involved in the fire watch is to be adequate such that the Contractor's entire area of construction work is patrolled during the fire watch.
- .4 The building shall be patrolled at least once per hour on a 24-hour basis until the fire alarm and or fire protection system has been restored to normal operation condition.
- .5 Fire watch personnel are to be familiar with facilities and procedures for sounding an alarm in the event of a fire and have a means of notifying the Emergency Services. The person(s) performing fire watch are not permitted to perform any other duties at the same time.
- .6 Fire watch personnel are to have fire-extinguishing equipment readily available and be trained in its use.
- .7 Implement all fire protection system impairments in accordance with the National Fire Code of Canada and Base Fire Orders.

1.8 FIRE EXTINGUISHERS

- .1 In addition to other requirements of this specification, supply fire extinguishers, as scaled by the CFPO, necessary to protect work in progress and contractor's physical plant on site.
- .2 Fire extinguishers may be required in the following areas as directed by the CFPO.
 - .1 Adjacent to hot works;
 - .2 In areas where combustibles are stored;
 - .3 Near or on any internal combustion engines;
 - .4 Adjacent to areas where flammable liquids or gases are stored or handled;
 - .5 Adjacent to temporary oil fired or gas fired equipment; and
 - .6 Adjacent to bitumen heating equipment.
- .3 Extinguishers shall be sized as 4-A: 40-B: C (20 lbs) unless otherwise directed by the CFPO.
- .4 Extinguishers shall be of the dry chemical type unless otherwise required by the hazard being protected.
- .5 The Contractor may assume the quantity of extinguishers based on a maximum travel distance between extinguishers of 75 feet.

1.9 INSTALLATION OR REPAIR OF ROOFS

- .1 Notify the CFPO of location of asphalt kettles and dates that kettles will be in use. Ensure personnel use and take precautions as follows:
 - .1 Use kettles equipped with thermometers or gauges in good working order.

- .2 Locate kettles in safe place outside of building or, if approved by CFPO, on non-combustible roof. Locate to avoid danger of igniting combustible material below.
- .3 Maintain continuous supervision while kettles are in operation and provide metal covers for kettles to smother flames in case of fire. Provide fire extinguishers as required in 1.08.
- .4 Prior to start of work, demonstrate container capacities to CFPO.
- .5 Use only glass fibre roofing mops.
- .6 Do not leave used roofing mops unattended on roof. Store mops away from building and combustible materials.
- .7 Store roofing materials no closer than 3.0 metres from structures.
- .8 Any flammable cylinder shall be secure to prevent accidental tip over.

1.10 ACCESS FOR FIRE FIGHTING

- .1 Access for firefighting shall be provide in accordance with National Fire Code of Canada.
- .2 Advise the CFPO of work that would impede fire apparatus response. This includes violation of minimum horizontal and overhead clearances, as prescribed by the CFPO, erecting of barricades and digging of trenches.
- .3 Minimum horizontal clearance: clear width of not less than 5.0 meters or as defined by the CFPO.
- .4 Minimum vertical clearance: overhead height of not less then 6.0 meters, or as defined by the CFPO.

1.11 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in all buildings. Observe posted smoking restrictions near existing buildings. Smoking areas will be IAW Base Fire Orders and will not be within 10 meters of any building entrance.

1.12 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.
- .2 Burning of rubbish is prohibited.
- .3 Remove rubbish from work site at end of work day or shift as directed.
- .4 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
- .5 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.13 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handle, store and use flammable and combustible liquids in accordance with National Fire Code of Canada.

- .2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Obtain written authorization from CFPO for storage of quantities of flammable and combustible liquids exceeding 45 litres on site.
- .3 Do not transfer flammable or combustible liquids inside buildings or on jetties.
- .4 Do not transfer flammable or combustible liquids in vicinity of open flames or any type of heat-producing devices.
- .5 Do not use flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents.
- .6 Store flammable and combustible waste liquids, for disposal, in approved containers located in safe ventilated area. Keep quantities to a minimum and notify CFPO when disposal is required.

1.14 HAZARDOUS SUBSTANCES

- .1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, shall be in accordance with National Fire Code of Canada.
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate all sources of ignition. Inform the CFPO prior to and at completion of such work.

1.15 HOT WORKS

- .1 The Contractor shall implement a hot works program in accordance with the National Fire Code of Canada and NFPA 51 Standard for Fire Prevention during Welding, Cutting and Other Hot Work.
- .2 The Contractor shall obtain through their DCC Representative from the CFPO a "Hot Work" permit for all hot works in the construction area. Frequency of renewal for hot works permits is at the discretion of the CFPO. Request to be submitted 48 hours in advance of any hot work.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the CFPO.
- .4 Provide fire watch service for work on scale established and in conjunction with the CFPO as defined in the Fire Department Briefing. Fire watchers shall be trained in the use of fire extinguishing equipment. The person(s) performing fire watch are not permitted to perform any other duties at the same time.
- .5 Area of hot works
 - .1 Hot works shall be carried out in an area free of combustible and flammable content.
 - .2 Where not possible,

- .1 All flammable and combustible materials within 15m of the hot works shall be protected in accordance with the National Fire Code of Canada.
- .2 A fire watch shall be provided during the hot work and for a period of not less than 60 minutes unless otherwise directed by the CFPO.
- .3 A final inspection of the hot work area shall be conducted 1 hour after the completion of hot works unless otherwise directed by the CFPO.
- .3 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to the areas where the hot work is carried out:
 - .1 Openings in walls, floors or ceilings shall be covered or closed to prevent the passage of sparks to such adjacent areas.
- .6 Protection of flammable and combustible materials.
 - .1 Any combustible or flammable material, dust or residue shall be:
 - .1 Removed from the area where hot works is carried out; or
 - .2 Protected from ignition by non-combustible materials.
- .7 Fire extinguisher
 - .1 A fire extinguisher shall be provided within 3 m of all hot works. Minimum size shall be 20lbs ABC unless otherwise directed by CFPO.
- .8 Temporary heating
 - .1 No open flame heaters can be used on construction site.
 - .2 Only forced air heaters ULC or CSA approved and rated for industrial or construction use shall be used.
 - .3 All electric heaters shall be connected on a proper and individual circuit.

1.16 PARTIAL OCCUPANCY

- .1 Implement partial occupancy procedures as defined in the drawings and specifications. Partial occupancy is where construction occurs adjacent to work areas occupied by the Canadian Forces personal. This includes:
 - .1 Phased new construction.
 - .2 Early or partial occupancy of new construction.
 - .3 New construction being added onto an existing building.
 - .4 Renovation or recapitalization of an existing building.
 - .5 Phased renovation or recapitalization of an existing building.
- .2 Where partial occupancy occurs, Contractor shall implement requirements as found in the drawings and specifications. This may include construction of a rated fire separation between occupied and construction areas as required by National Fire Code.
- .3 A watch, with tours at intervals of not more than one hour, shall be provided throughout demolition sites when there are occupants in the portion of the building not being demolished.

- .4 Except where a building is provided with a fire alarm system equipment, a watch, with tours at intervals of not more than one hour, shall be provided when a portion of the building is occupied while construction operations are taking place.

1.17 FALSE ALARM FEES

- .1 “False Alarm” is the activation of a Fire Alarm System or emergency system through a mechanical failure, equipment malfunction, improper installation of the system or failure to maintain the system as described by the Ontario Fire Code being O.Reg.388/97, under the Fire Protection and Prevention Act, 1997, S.O. 1997, c.4, as amended.
- .2 The Contractor shall not undertake work on any Fire Alarm System that sends an alarm directly to the Kingston Fire & Rescue or a Fire Alarm Monitoring Service without the DCC Representative being notified 48 hours in advance first.

1.18 QUESTIONS OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety in addition to above requirements to the DCC Representative.
- .2 DCC Representative is responsible to obtain clarification from the CFPO. The Contractor is not to liaise directly with the CFPO for notification, authorization or any requests unless the situation constitutes an immediate emergency.

1.19 FIRE INSPECTION

- .1 Co-ordinate site inspections by CFPO through DCC Representative.
- .2 Allow CFPO unrestricted access to work site.
- .3 Co-operate with CFPO during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by CFPO.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Impact Assessment Act, 2019
- .2 Canadian Environmental Protection Act, 1999
- .3 Fisheries Act, 1985
- .4 Transportation of Dangerous Goods Act, 1992
- .5 Ontario Environmental Protection Act, 1990
- .6 Ontario Regulation 347 – General – Waste Management
- .7 Wing Standing Order (WSO) 15.04 Emergency Response to Hazardous Materials Spills

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities submit an Environmental Protection Plan to include the following:
 - .1 Spill Prevention and Response Plan.
- .3 Submit other data, information and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.

1.3 GENERAL

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in section 1.0 References, noted above.
- .2 The Work site is subject to inspection by the Base Environment Officer, or designate, as well as, the DCC Representative, without prior notice.
- .3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.
- .4 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.
- .5 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.
- .6 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.

- .7 Blasting is not permitted on DND property.
- .8 Fires and burning of rubbish are not permitted on DND property.

1.4 SPILLS AND REPORTING SPILLS

- .1 A spill or release is an accidental discharge of a pollutant (solid, liquid or gas) into the environment. After a spill or release, always ensure human health and safety is protected above all else.
- .2 All spills, regardless of size, that occur on DND property shall be reported to the Base Fire Hall and 1 Wing Environment. This includes all spills of any substance that is or is of suspect of being a hazardous or environmentally hazardous substance.
- .3 Substances such as engine oil, hydraulic fluid, fuel, paint, varsol, thinners and other petroleum-based products where storage containers do not always indicate a hazardous material, are considered hazardous to the environment. These materials must be stored in secondary containment and all Safety Data Sheets (SDS) must be readily available on site. Treat all spills in accordance with the regulations.
- .4 Submit to the DCC Representative a project-specific Spill Prevention and Response (SPR) Plan prior to work on-site.
 - .1 The SPR shall include environmental response measures necessary to prevent and to mitigate a pollutant release on National Defence property.
 - .2 The SPR is to include: roles and responsibilities, contact information, spill notification procedure, emergency spill response measures, project and site-specific clean up measures for spills, waste disposal, restoration activities, and reporting requirements.
 - .3 Identify storage locations of materials or wastes that may require emergency spill response. Identify spill control kit inventory and location(s).
 - .4 SPR shall identify equipment fueling location, methodology and control measures. Refueling operations shall be conducted within a secondary containment area. Refuel equipment no closer than 30 metres from water bodies.
- .5 The SPR is to be modified and updated as necessary. On-going assessments shall be performed during the progress of work identifying and documenting new or potential spill hazards and measures not previously known and identified.
- .6 Prior to starting work, provide to the DCC Representative an inventory of hazardous material to be brought to the site, including volume or mass, and Safety Data Sheets (SDS).
- .7 Display an information placard on all such material and equipment containing liquid products that will be located overnight or longer on DND property.
 - .1 Information placards to include: Contractor's name and address, contact person, emergency telephone numbers, and liquid contents.
 - .2 Post the information placard either on the exterior of the container, or on the dashboard of the vehicle, where applicable.
- .8 The Contractor is to prepare an Emergency Spill Response Plan to deal with potential leaks and spills during their operations on site.

- .1 Emergency Response:
 - .1 With respect to liquid spills, provide enough on-site equipment to control for one hour a liquid spill of 110% of any material brought on to—or handled at—the site.
 - .2 The on-site spill control kit required to include absorbent pads, absorbent granular, nitrile gloves, garbage bags and/or pails with lids, and shovels, and applicable to the chemical used. A spill control kit shall be located wherever significant quantities of materials or wastes that may require emergency spill response are used or stored.
 - .3 In the event of a spill, invoke Contractor's SPR Plan and make immediate notifications to Base Fire Hall, DCC Coordinator, and Wing Environment.
 - .4 In the event of a spill into the natural environment, do everything practicable to prevent, eliminate, and ameliorate adverse effects, and to restore the natural environment.
 - .5 Emergency response planning is to include measures to escalate the response in the event of an emergency that exceeds on-site equipment capabilities.
- .9 The Contractor must ensure all emergency response equipment be available on site to deal with any spills and leaks, is of sufficient size to contain the largest amount of fluid on site, as well as ensure their personnel are trained to respond.
- .10 All spills must be reported by dialling the Base Fire Hall at 911. The Wing Environmental Officer, the Project Manager and DCC must also be informed immediately.
- .11 A spill report must be completed by the Contractor and sent to 1 Wing Environment within 24 hours of the spill occurring as per WSO 15.04 Emergency Response to Hazardous Materials Spills.

1.5 DISPOSAL OF WASTE

- .1 Do not bury rubbish and waste materials on site.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm, floor or sanitary sewers.
- .3 Remove legally and dispose of off site all surplus materials, debris, and waste materials resulting from the proposed project activities.
- .4 All waste and excess materials shall be disposed in accordance with all Provincial regulations and requirements.
- .5 All rubbish and/or waste must be transported and disposed of at a licensed facility off National Defence property compliant to the Provincial Regulatory requirements.
- .6 Waste contaminated by chemicals, hydrocarbons or other sources due to on site releases and spills by the Contractor must be disposed of at a licensed facility off National Defence property. DND's waste generator number is not to be used for waste disposal purposes. The Contractor shall provide their own waste generator number.

- .7 Copies of all waste manifests and documentation resulting from the project activities shall be submitted to DCC and Wing Environment.

1.6 DRAINAGE

- .1 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- .3 Ensure that sufficient erosion control measures are in place prior to project commencement and are monitored and maintained throughout the duration of the project.

1.7 POLLUTION CONTROL

- .1 Control emissions from equipment and plant to local authorities' emission requirements.
- .2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

1.8 ENVIRONMENTAL MITIGATION MEASURES

- .1 No refuelling in the vicinity of any watercourse or drainage system. A refuelling area complete with spill response equipment is to be established at a minimum of 30 meters from any shoreline, water course or catch basin.
- .2 Prevent construction debris, chemicals, hydrocarbons and contaminated effluent from entering the storm water drainage system. Cover catch basins, floor drains and manhole inlets on site.
- .3 Waste or contaminated materials must not be released into the storm water system or all other waterways. Install erosion control measures to prevent sediment migration into streams or watercourses.
- .4 All spills regardless of size or chemical compound (hydrocarbons, NPRI, or other) must be reported in accordance with contract requirements.
- .5 All potentially contaminating chemical compounds will be stored away from water or sewage areas and will have secondary containment.
- .6 Tools and construction materials removed from site must be inspected and cleaned prior to leaving the site.
- .7 The Contractor shall monitor site activities on a daily basis with respect to waste control devices, secondary containment for chemical compounds and general site conditions. Any anomalies must be noted, dealt with and reported to DCC/DND OPI.
- .8 Site disturbances shall be restored prior to project completion.
- .9 Environmental Protection to be provided by DCC based on the Environmental Impact Assessment.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 Cleaning & Waste Management.
 - .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 & Waste Management.
- .3 Waste Management: separate waste materials for recycling.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 RELATED REQUIREMENTS

- .1 Perform Work in accordance with the latest National Building Code of Canada (NBC) including amendments up to tender closing date provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: Except as otherwise specified, Contractor shall apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission; and
 - .2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

Part 2 Products

2.1 NOT USED

- .1 Not Used.

2.2 EASEMENTS AND NOTICES

- .1 Contractor to confirm with DCC Representative that surrounding infrastructure is owned and operated by DND.

- .1 If true, DCC Representative to notify DND PM to contact Property Officer for their comments.
- .2 Contractor is not permitted to work on any infrastructure owned by municipality, other government departments, or a third-party owner (for example, utility companies).
- .3 Contractor is to get written permission from DCC Representative through DND PM and Base Property Officer if work is required on DND owned utilities that cross an easement.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 78 00 – Closeout Submittals.

1.2 GENERAL

- .1 Quality control remains the responsibility of the contractor. DCC Representative provides Quality Assurance.
- .2 Contractor shall provide a contract specific Quality Control Plan to the DCC Representative for review and acceptance prior to first progress payment. The contract specific Quality Control Plan shall include specific and detailed responsibilities of the Contractor's staff to demonstrate how they will ensure that the Work meets the specifications and drawings of the Contract.

1.3 INSPECTION

- .1 Allow DCC Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by DCC Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 DCC Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, DCC Representative will pay cost of examination and replacement.

1.4 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies may be engaged by DCC Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by DCC Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as

advised by DCC Representative at no cost to DCC Representative. Pay costs for retesting and reinspection.

1.5 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.6 PROCEDURES

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

1.7 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by DCC Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

1.8 REPORTS

- .1 Submit 1 electronic copy of inspection and test reports to DCC Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.9 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.

1.10 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to DCC Representative.
- .3 Prepare mock-ups for DCC Representative's review with reasonable promptness and in orderly sequence, to not cause delays in Work.

.4 Failure to prepare mock-ups 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.

.5 If requested, DCC Representative will assist in preparing schedule fixing dates for preparation.

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1.11 MILL TESTS

.1 Submit mill test certificates as required of specification Sections.

1.12 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical, and building equipment systems.

.2 Refer to Sections for definitive requirements.

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 REFERENCES

- .1 Occupational Health and Safety Act (OHSA)
- .1 Ontario Regulation 213/91 for Construction Projects.

1.2 INSTALLATION REMOVAL

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Coordinate with governing authorities and obtain required permits.
- .3 Remove from site all such work after use.

1.3 FUNCTIONAL REQUIREMENTS

- .1 Provide all necessary hoists for work.
- .2 Locate hoists where directed by DCC Representative.

1.4 DESIGN CRITERIA

- .1 When required by code, scaffolding and scaffold enclosures shall be designed and certified by a Professional engineer, retained by contractor and licensed in the Province of Ontario. The same Professional engineer must approve, in writing, additions or modifications to scaffolding.
 - .1 Scaffold and enclosure must be built to withstand, and all wind, rain and snow loads applicable to construction site in accordance with NBC and OBC.
 - .2 Scaffold may be loaded up to 2.40 kPa. No more than 5 (five) working levels shall be loaded at one time.
- .2 Where scaffolding must be supported by existing structures, DCC Representative shall provide on request, information from the Owner on the condition and capacity of the existing structure in sufficient detail to allow the Contractor to complete scaffolding design.

1.5 GENERAL REQUIREMENTS FOR SCAFFOLDING

- .1 Power elevated platforms may be used as part of the access system for the work if suitable to complete the work and provide access for inspection. Use of elevated work platforms shall be subject to remaining within the load lifting limits of such machines, accommodating traffic required for operations (delivery, garbage, recycling trucks etc.) and providing ready access to both the DCC Representative and designated inspectors such that the work can be inspected while in progress and once complete. Design scaffolds as follows:
 - .1 Platforms shall be prefabricated clip platforms, planks are not permitted.
 - .2 Scaffolds shall have proper stairs; ladders and trap doors are not permitted.
 - .3 Scaffolds shall be built of modular parts whenever possible.

- .4 Scaffold accessories including braces and jackscrews shall be compatible with the capacity of frames.
- .5 Provide internal horizontal x-bracing at all planking levels.
- .6 Platforms shall be wide enough to circulate and temporarily store materials.
- .7 Platforms shall be designed to support extra loads of removed materials.
- .8 Provide steel guardrails, including toe boards, intermediate rails and handrails, at perimeter and around openings of all work platforms.
- .9 Scaffold design and erection shall be in accordance with the "Occupational Health And Safety Act" and "Regulations For Construction Projects", and relevant municipal, provincial and federal regulations.
- .2 Scaffolding shall be tied back to the masonry using push-pull ties. Scaffolding shall be isolated from walls or surfaces with 12 mm thick rubber or neoprene pads. Show all anchor locations and ties on shop drawings. DCC Representative shall review anchor locations prior to installation.
- .3 Scaffold roofs shall be waterproof and meet Design Criteria.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit for review shop drawings of scaffold and weather enclosure system including:
 - .1 Scaffold assembly drawings.
 - .2 Scaffold anchoring.
 - .3 Enclosure fabric with fastening and support system if applicable.
 - .4 Waterproofing details for scaffold roof.
 - .5 Indicate on drawings distance from platforms to wall surface to be worked on.

Part 2 Products

2.1 TUBULAR SCAFFOLD

- .1 Tubular scaffold, scaffold bridge, stair, side brackets, work platforms, guardrails, barricades, and other accessories shall be an engineered type modular tubular scaffold system.
- .2 Complementary 50 mm diameter tube and clamp assemblies may be used where structural reinforcement is required and/or irregular geometry prevents use of modular parts.
- .3 All components shall be hot dip galvanized steel.
- .4 Platforms shall be clip type prefabricated platforms; wood planks are not permitted.

2.2 ACCESSORIES

- .1 Spacers and protection pads: rubber or neoprene spacers: 12 mm thick min.

- .2 Pipe fasteners: 3 mm thick min. galvanized steel fasteners designed for 25 mm and for 50 mm exterior diameter tubing.

Part 3 Execution

3.1 INSTALLATION

- .1 The erection of the scaffold cannot commence prior to review of the shop drawings.
- .2 A competent worker shall supervise erection of the scaffold.
- .3 Professional engineer that prepared shop drawings shall inspect the scaffold before it is used to ensure that it is erected in accordance with design drawings.
- .4 Scaffolds:
 - .1 Install engineered scaffold, stairs and aluminum track system in accordance with approved shop drawings and mock-ups.
- .5 Enclosure and netting:
 - .1 Use plastic wrap ties to fasten netting securely to scaffolding where applicable.

3.2 REMOVAL

- .1 Remove temporary scaffolding and enclosures when directed by DCC Representative.
- .2 Coordinate removal work DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 52 00 – Construction Facilities.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures.
- .3 Section 02 41 13 – Selective Site Demolition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

1.4 DEWATERING

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

1.5 WATER SUPPLY

- .1 Existing water supply may be used free of charge, for construction requirements with prior approval of DCC Representative. Make good any damage.
- .2 DCC Representative will determine delivery points and quantitative limits. Written permission is required before any connection is made. All connections to be completed by licensed trade as required by regulatory and approval authorities.
- .3 Provide at no cost to DND, all equipment and temporary lines to bring these services to project site.
- .4 Supply of temporary services by DND is subject to DND requirements and may be discontinued by DND site representative at any time without notice, without acceptance of any liability for damage or delay, caused by such withdrawal of temporary services.

1.6 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 All equipment shall be in good working order and approved by a recognized certification agency.

- .3 Prior to the use of any heating equipment the Chief Fire Inspector of the Base shall be notified and the equipment and installation inspected before any use.
- .4 No temporary heating equipment utilizing an open flame will be allowed.
- .5 Unless explicitly stated elsewhere in the specifications, the contractor is responsible for all heating cost, including equipment, fuel, electricity and maintenance personnel as required for the duration of the project.
- .6 Construction heaters used inside building must be vented to outside or be flameless (vent free) type. Solid fuel salamanders are not permitted.
- .7 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .8 Maintain temperatures of minimum 10 degrees Celsius in areas where construction is in progress.
- .9 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .10 Permanent heating system of building be used when available. Be responsible for damage to heating system if use is permitted.
- .11 On completion of Work for which any existing systems to remain are used, ensure that they are returned to original state, including cleaning of equipment and the replacement of any filters or consumable elements.
- .12 When authorized by the DCC Representative, Contractor may use existing building equipment for temporary heat source.
- .13 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.
- .14 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

- .1 Arrange and maintain temporary electrical power supply in accordance with governing regulations and ordinances.
- .2 DND may provide, free of charge, temporary electrical power for construction purposes. Electrical power provided by DND is not to be utilized for temporary heating.
- .3 DCC Representative will determine delivery points and quantitative limits. Written permission is required by DCC Representative before any connection is made. Connect to existing power supply in accordance with the Canadian Electrical Code. All connections to be completed by licenced trade as required by regulatory and approval authorities.
- .4 Provide, at no cost to DND, all equipment and temporary lines to bring these services to project site.
- .5 Supply of temporary services by DND is subject to DND requirements and may be discontinued by DND site representative at any time without notice, without acceptance of any liability for damage or delay, caused by such withdrawal of temporary services.
- .6 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor based on General Conditions of Contract.
- .7 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .8 Provide and pay for temporary construction power, unless agreed otherwise with DCC Representative.
- .9 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of DCC Representative provided that guarantees are not affected.
 - .1 Repair damage to electrical system caused by use under this Contract.
 - .2 Replace lamps which have been used for more than 3 months.

1.8 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax, data hook up, lines and necessary for own use and use of DCC Representative.

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 RELATED REQUIREMENTS

- .1 Section 01 51 00 – Temporary Facilities.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures.

1.2 REFERENCE STANDARDS

- .1 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.
- .2 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.
- .3 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 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.

1.5 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.

- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs.

1.6 HOISTING

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

1.7 SITE STORAGE/LOADING

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

1.8 CONSTRUCTION PARKING

- .1 Parking will be permitted on site.
- .2 DCC Representative will determine where Parking will be permitted on site. Maintain and administer these spaces as directed.
- .3 Provide and maintain adequate access to project site.

1.9 OFFICES

- .1 Provide office heated to 22 degrees C, lighted and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid kit in a readily available location.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds when required by contractor 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.
- .3 Storage location to be approved by DCC Representative.

1.11 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances, if required.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

- .3 Permanent facilities may be used on approval of DCC Representative.

1.12 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign, upon Contractor's mobilization to site, in a location designated by DCC Representative.
- .2 No other signs or advertisements, other than warning signs, are permitted on site.
- .3 Direct requests for approval to erect Contractor signboard to DCC Representative. For consideration general appearance of Contractor signboard must conform to project identification site sign. Wording in both official languages.
- .4 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .5 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by DCC Representative.

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 DCC Representative.
- .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 DCC Representative.

- .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 for Contractor's Roads.
- .14 Remove, upon completion of work, haul roads designated by DCC Representative.

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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 When working on travelled way:
 - .1 Place equipment in position to minimize interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .3 Close lanes of road only after receipt of written approval from DCC Representative.
 - .1 Before re-routing traffic erect suitable signs and devices to Ontario Traffic Manual, Book 7: Temporary Conditions.
- .4 Keep travelled way graded, free from pot holes and of sufficient width for required number of lanes of traffic.
 - .1 Provide 7 m wide minimum temporary roadway for traffic in two-way sections through Work and on detours.
 - .2 Provide 5 m wide minimum temporary roadway for traffic in one-way sections through Work and on detours.
- .5 Provide detours or temporary roads as indicated, and as approved by DCC Representative to facilitate passage of traffic around restricted construction area:
- .6 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, except where other means of road access exist that meet approval of DCC Representative.

1.2 INFORMATIONAL AND WARNING DEVICES

- .1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response, as approved on traffic control plan by DCC Representative.
- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices to Ontario Traffic Manual, Book 7: Temporary Conditions.
- .3 Place signs and other devices in locations recommended in Ontario Traffic Manual, Book 7: Temporary Conditions.
- .4 Meet with DCC Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of DCC Representative.

- .5 Continually maintain traffic control devices in use:
 - .1 Check signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Remove or cover signs which do not apply to conditions existing from day to day.

1.3 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag personnel, trained in accordance with, and properly equipped to Ontario Traffic Manual, Book 7: Temporary Conditions for situations as follows:
 - .1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.
 - .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
 - .7 At each end of restricted sections where pilot cars are required.
 - .8 Delays to public traffic due to contractor's operators: 15 minutes maximum.
- .2 Where necessary, provide pilot cars. Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.
- .3 Where roadway, carrying two-way traffic, is restricted to one lane, for 24 hours each day, provide portable traffic signal system.
 - .1 Adjust, as necessary, and regularly maintain system during period of restriction.
 - .2 Ensure signal system meets requirements of Traffic Accommodation in Work Zones and Ontario Traffic Manual, Book 7: Temporary Conditions, and any other manual specified by the DCC Representative.

1.4 OPERATIONAL REQUIREMENTS

- .1 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified and approved by DCC Representative to protect and control public traffic, specific traffic restriction measures will be allowed.
- .2 Maintain existing conditions for traffic crossing right-of-way.

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 RELATED REQUIREMENTS

- .1 Section 01 51 00 – Temporary Utilities.
- .2 Section 01 52 00 – Construction Facilities.
- .3 Section 02 41 13 – Selective Site Demolition.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-0, Exterior Alkyd Primer for Wood.
- .2 CSA Group (CSA)
 - .1 CSA-O121- M1978(R2003), Douglas Fir Plywood.

1.3 INSTALLATION AND REMOVAL

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

1.4 HOARDING

- .1 Erect temporary site enclosures using mm construction grade lumber framing at mm centers and mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically
- .3 Provide lockable truck entrance and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .5 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.
- .6 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.5 GUARD RAILS AND BARRICADES

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

- .2 Provide as required by governing authorities.

1.6 WEATHER ENCLOSURES

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

1.7 DUST TIGHT SCREENS

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

1.8 ACCESS TO SITE

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

1.9 PUBLIC TRAFFIC FLOW

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

1.10 FIRE ROUTES

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

1.11 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred by Work, to previous or better condition.

1.12 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with DCC Representative locations and installation schedule at least 10 working days prior to installation.

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

1.13 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 35 43 - Environmental Protection.

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 RELATED REQUIREMENTS

- .1 Section 01 45 00 – Quality Control.

1.2 REFERENCE STANDARDS

- .1 Within text of each specifications section, reference may be made to reference standards
- .2 Conform to latest date of issue of referenced standards in effect on date of submission of Tender, except where specific date or issue is specifically noted.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, DCC Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by DCC Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.3 QUALITY

- .1 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.
- .2 Within 7 Calendar days of written request by DCC Representative, submit following information for materials and equipment proposed for supply:
 - .1 Name and address of manufacturer.
 - .2 Trade name, model catalogue number.
 - .3 Performance and test data.
 - .4 Manufacturers installation instructions.
 - .5 Evidence of arrangement to procure.
- .3 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.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with DCC Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 CONTRACTOR'S OPTIONS FOR SELECTING MATERIALS FOR TENDERING

- .1 Products specified by naming three or more, select any product named. Materials listed as "Acceptable Products" within the contents of this specification identify products known to meet the specified criteria. Other products may exist which meet the requirements specified but have not been listed as "Acceptable Products".
- .2 Where 3 products are listed, the Contractor will choose one of the listed products. If Contractor desires to use alternate products in lieu of the listed acceptable products, the Contractor will follow specified procedures for requesting the use of alternate products - DCL242. The term "Acceptable Product" is deemed to be a complete and working commodity as described by a manufacturer's name, catalogue number, trade name or any combination thereof.

1.5 SUBSTITUTION

- .1 No substitutions will be permitted after tender award except under special circumstances described herein.
- .2 A substitution request must include statements of respective costs of items originally specified and the proposed substitution and itemize any differences in quality, performance and warranty.
- .3 A substitution request may be considered by the DCC Representative if:
 - .1 materials selected from those specified are not available, discontinued; or
 - .2 delivery date of materials selected from those specified would unduly delay completion of contract; and
 - .3 alternative material to those specified is equivalent in quality, performance and warranty to the material specified and will result in a credit to the Contract amount.
- .4 Should substitution be accepted either in part or in whole, assume full responsibility and cost when substitution affects other work on project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of substitution will be determined by DCC Representative and Contract Price will be reduced accordingly.

1.6 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, such as lumber and metal siding 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 DCC Representative.
- .9 Touch-up damaged factory finished surfaces to DCC Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Products supplied by Owner will coordinated by DCC Representative, unless otherwise noted in Contract Documents.

1.8 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 DCC Representative in writing, of conflicts between specifications and manufacturer's instructions, so that DCC Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes DCC Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.9 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 DCC Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. DCC Representative 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 DCC Representative, whose decision is final.

1.10 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.

1.11 CONCEALMENT

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

1.12 REMEDIAL WORK

- .1 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.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.13 LOCATION OF FIXTURES

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

1.14 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.

1.15 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.

1.16 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 DCC Representative.

1.17 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by DCC Representative, with minimum of disturbance to Work, building occupants, pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered notify DCC Representative, 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 REFERENCE STANDARDS

- .1 Owner's identification of existing survey control points and property limits.

1.2 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Place of Work.

1.3 SURVEY REFERENCE POINTS

- .1 Use when applicable.
- .2 Existing base horizontal and vertical control points are designated on drawings.
- .3 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .4 Make no changes or relocations without prior written notice to DCC Representative.
- .5 Report to DCC Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .6 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

- .1 Use when applicable.
- .2 Locate and confirm existing bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Stake for grading, fill and topsoil placement and landscaping features.
- .5 Stake slopes.
- .6 Establish pipe invert elevations.
- .7 Stake excavation envelope.
- .8 Stake batter boards for foundations.
- .9 Establish foundation column locations and floor elevations.
- .10 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work, all Base and Provincial Locate must be in hand before work may commence.
- .2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by DCC Representative.
- .3 Notify DCC Representative 1 week prior to backfill or capping of any utilities below grade.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform DCC Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment to DCC Representative.

1.7 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to DCC Representative.
- .2 On request of DCC Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.9 SUBSURFACE CONDITIONS

- .1 Investigate and promptly notify DCC Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

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 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor (if applicable).
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Restore work with new products in accordance with requirements of Contract Documents.
- .8 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .9 Provide firestopping in to maintain the integrity of fire separations, including:
 - .1 Protecting penetrations at fire-resistance rated wall, ceiling or floor construction.
 - .2 Using construction joint fire stops and building perimeter fire stops to protect gaps at fire separations and between fire separations and other construction assemblies.
- .10 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection or as indicated in contract documents. Refinish assemblies by refinishing entire unit.
- .11 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

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 RELATED REQUIREMENTS

- .1 Section 01 78 00 – Closeout Submittals.

1.2 REFERENCE STANDARDS

- .1 Conduct cleaning and disposal operations in accordance with all Federal, Provincial or Municipal regulatory requirements and guidelines for environmental protection.
- .2 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation system is not permitted for this purpose.
- .3 This section does not apply to cleaning associated with hazardous material removal and disposal operations. Cleaning of these areas is covered in other sections. Once certified as safe by DCC Representative cleaning methods specified herein are applicable.

1.3 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris at regulated waste facility off site.
- .6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.4 FINAL CLEANING

- .1 When Work is Substantially Completed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris and leave Work clean and suitable for occupancy.

- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Do not burn waste materials on site.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass if damaged by the Work.
- .7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors, if caused by the Work.
- .8 Clean lighting reflectors, lenses, and other lighting surfaces.
- .9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .15 Sweep and wash clean paved areas.
- .16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .17 Clean roofs, downspouts, and drainage systems.
- .18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .19 Remove snow and ice from access to building.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Complete in accordance with 01 35 43 - ENVIRONMENTAL PROTECTION 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 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re modeling, and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Non hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non toxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 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.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 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.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:

- .1 Solvents in paints and other coatings;
 - .2 Wood preservatives; strippers and household cleaners;
 - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 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.

1.2 MATERIALS SOURCE SEPARATION PROGRAM

- .1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .2 Provide containers to deposit reusable and recyclable materials.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated material(s) in area(s) which minimize material damage.
- .5 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Store/stockpile materials to be reused, recycled and salvaged in locations as directed by DCC Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect surface drainage, mechanical and electrical from damage and blockage.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
- .3 Dispose of all waste materials off-site at licensed facility in accordance with appropriate provincial and municipal regulations.
- .4 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 APPLICATION

.1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work and leave work area in clean and orderly condition.

.2 Clean up work area as work progresses.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Redline Drawings are those prepared by the Contractor as it constructs the project and upon which it documents the actual locations of the building components and site components and changes to the original contract.
- .2 Record Drawings are prepared by the DCC Representative based on information taken from the Contractors Redline Drawings, are not included in the scope of work unless stated in the contract documents.

1.2 GENERAL

- .1 The following shall be submitted in the close out package for approval in folders described in this divisional section.
 - .1 Scanned Redline Drawings
 - .2 Field Survey Data
 - .3 O&M Manual
 - .4 Approved Shop Drawings
 - .5 Warranty Information and if available;
 - .6 Reports
 - .7 Photos
 - .8 Spare parts, special tools and maintenance materials, as indicated in contract documents.

1.3 FORMAT

- .1 The main folder structure for the closeout package submittal is to be organized as follows;
 - .1 910 - Redline Drawings
 - .2 920 - Record Drawings
 - .1 921 - Field Survey Data
 - .3 930 - O&M Manual
 - .4 940 - Approved Shop Drawings
 - .5 950 - Warranty Information
 - .6 960 - Reports
 - .7 970 – Photos
 - .8 980 - Spare parts, special tools and maintenance materials, as indicated in contract documents.
- .2 Only electronic format is to be submitted.
- .3 Allow 10 working days for closeout package to be reviewed by DCC Representative and DND Project Manager.

- .4 All Cover Sheets: Project Title, Building Number, Drawing Number, Project Number, DCC KN Number and identify subject matter of contents.
- .5 Arrange content by Specification Section numbers and sequence of Table of Contents.
- .6 Provide separate sections for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Submission is to be provided using DCC's electronic file transfer platform.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Three weeks prior to Substantial Completion of the Work, submit to the DCC Representative, an electronic copy 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 .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.5 REDLINE DRAWINGS

- .1 As-Built, Field Record Drawings and Redlines are interchangeable terms meaning Redlines.
- .2 Contractor is to provide a printed copy of the drawing set for the intended purpose of creating redline drawings with the words "Redlines" in red written on each page.
- .3 Contractor to record changes in red as made and authorized on one set of prints referred to as "Redline Drawings" and at substantial completion of project and prior to final inspection scan and submit drawings to DCC Representative. DCC Representative will review and initial to concur with the content of the final markups.
- .4 All Site Instruction Numbers and Change Order Numbers are to be annotated on the Redline Drawing set.
- .5 Contractor to maintain information on project site drawings and record accurately, deviations of newly installed or existing plant works from Contract documents during construction.
- .6 Contractor will submit for record drawings purposes the original set of redline drawings from construction site used for keeping track of contract design and site condition changes.
- .7 The Contractor shall ensure but not limit to the recording of the following information on the original Redline drawings:
 - .1 Depths of various elements of foundation in relation to first floor level or finished grade elevation.
 - .2 Horizontal and vertical locations of existing and new underground utilities and appurtenances as well as the alignment, bend and curves of buried utilities such as

communication, power, water, sewer, storm and natural gas ducts, pipes and lines shall be surveyed and be geographically referenced to the coordinate system of the drawing or accurately dimensioned to surfaces features shown in the drawing.

- .3 Locations of internal utilities and appurtenance concealed in construction, referenced to visible and accessible features of structure.
- .4 Field changes of dimension and detail, such as but not limited to:
 - .1 For Buildings: Door locations, duct sizes, piping valve, and equipment layout, cable tray alignment.
 - .2 For Civil/Utilities: road widths, curve radii, alignment, curb radii, sidewalk extents, conduit/pipe sizes.
- .5 Changes made by Change Order.
- .6 Utilities shall be identified as abandoned, existing or new.

1.6 **RECORD DRAWINGS**

- .1 Record Drawings are to be created in AutoCAD using version 2014 or later.
- .2 Where contract drawings are created in BIM, the BIM model shall be submitted.
- .3 All Redlines markups are to be displayed on a new layer in AutoCAD called '_ANNO_REDLINES' which will print in black and white.
- .4 Contractor shall ensure the information from the original redline drawings is accurately transferred to AutoCAD drawings using the latest DND CAD/BIM Standards. Standards are available online or on CD from DND PM.
- .5 Each drawing should be saved as one individual AutoCAD file.
- .6 Once record drawings have been created, each CAD file is to be saved as an individual PDF file in the same sheet size as the AutoCAD drawing. DCC Representative will review the submitted PDF files to confirm accuracy of the transfer of redlines to record drawings.
- .7 PDF versions of AutoCAD Record Drawing tiles shall have the same name as the source AutoCAD file. (ie. K-B35-9302_2-301.dwg & K-B35-9302_2-301.pdf)
- .8 All AutoCAD drawings are to be 'bound', no external references will be accepted. Drawings are to be 'purged', 'audited' and saved 'zoom extents' in 'paper space'. Model space view shall be at zoom extents as well.
- .9 AutoCAD record drawings shall have "RECORD DRAWINGS" stamped in the title block.

1.7 **FIELD SURVEYING & DATA FILE**

- .1 Contractor to notify the DCC Representative with 2 working days' notice if any buried utility or infrastructure is being exposed to allow DND Surveyor to survey.
- .2 DND surveyor is allowed access to site to survey.
- .3 Should DND surveyor require special site safety training, the Contractor will notify DCC Representative prior to allow time to be trained.

- .4 Should the Contractor have their own Surveyor, and data is collected, it will be submitted with the closeout package.
- .5 Field survey data file for service structures, manholes, catch basins, vaults, valves, hydrants etc shall be submitted in excel sheet file format. DCC Representative will get an excel template to be populated from DND. File will contain preset fields to be populated.
- .6 Field survey performed for Municipal/Civil/Marine Works forming Part of Project shall:
 - .1 Be collected in ASCii format and shape file.
 - .2 ASCii file (Test File) shall contain point ID, Northing, Easting, Elevation and Descriptor.
 - .3 Shape files (.shp, ESR1 format) shall include point ID, Northing, Easting, Elevation and Descriptor.

1.8 O&M MANUALS

- .1 Electronic files are to be arranged and indexes into the same numerical order as the contract Specification Section. A maximum of 300 pages per file.
- .2 The use of Bookmarks within PDF is an acceptable practice.
- .3 Warranties are to remain in the Manual under each section.
- .4 Table of Contents for Each Volume: provide Project Title, Building Number, Drawing Number, DND Project Number, DCC KN Number;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Contractor with name of responsible parties.
 - .3 List of products and systems, indexed to content of volume.
- .5 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .6 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .7 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .8 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.
- .9 Training: refer to Section 01 79 00 - Demonstration and Training.

1.9 APPROVED SHOP DRAWINGS

- .1 Only copies of approved shop drawings and product data are to be submitted. Rejected and non-approved shop drawings and product data are not to be included.

- .2 Approved shop drawings for temporary works required to facilitate construction and that will be removed during or at the completion of construction are not required to be submitted in the closeout package.

1.10 WARRANTY

- .1 A Cover Sheet and Table of Contents containing all project related warranties with each item's expiry date is to be created.
- .2 All project related warranties are to be copied into this folder listed by specification section.
- .3 Submit a summary of warranty information to DCC Representative for any warranties.
 - .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 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.
- .4 Respond in timely manner to oral or written notification of required construction warranty in the closeout package.

1.11 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 co-ordination 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 01 91 13 - General Commissioning Requirements.

1.12 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.

1.13 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections to DCC Representative.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed by DCC Representative; place and store.

- .4 Receive and catalogue items.
 - .1 Submit inventory listing to DCC Representative.
 - .2 Include approved listings in Maintenance Manual.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections to DCC Representative.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed by DCC Representative; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to DCC Representative.
 - .2 Include approved listings in Maintenance Manual.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section to DCC Representative.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to location as directed by DCC Representative; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to DCC Representative.
 - .2 Include approved listings in Maintenance Manual.

1.14 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 DCC Representative.

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 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel as scheduled with the DCC Representative.
- .2 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation
 - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning Requirements and equipment and systems are fully operational.
- .3 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for DCC Representative's approval.
- .3 Provide electronic copy of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct personnel as designated by the DCC Representative.
 - .2 Provide written report that demonstration and instructions have been completed.

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 This Section specifies roles and responsibilities of Commissioning Training.

1.2 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Property, Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

- .1 Contractor and certified factory-trained manufacturers' personnel to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .2 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

- .1 Training to be detailed and sufficient in duration to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
 - .2 Effective on-going inspection, measurements of system performance.
 - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .4 Ability to update documentation.
 - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training to consist of demonstration of use and maintenance of equipment and systems.
- .3 DCC Representative and DND Project Manager will review training manuals.

- .4 Training materials to be in a format that permits future training procedures to same degree of detail.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be [3] hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

- .1 Contractor will be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
 - .4 Handouts including all necessary information (ie. flow charts, schematics, function / operations / interconnection information)

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .2 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .3 Maintenance and servicing, including spare parts recommended to be stored as site.
 - .4 Trouble-shooting diagnosis.
 - .5 Inter-Action among systems during integrated operation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

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 RELATED SECTIONS

- .1 Division 22 - Plumbing
- .2 Division 23 - Heating, Ventilation and Air-Conditioning
- .3 Division 26 - Electrical

1.2 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements of system functional performance testing, equipment, sub-system, systems, and integrated systems. Commissioning process to include start-up and dynamic operation of all systems install and documentation of Manufacture Start-up reports, DND Refrigerant Tracking documents.
- .2 References:
 - .1 DND Refrigeration Tracking Documents (DND Refrigerant Leak Testing in environmental section)
- .3 Acronyms:
 - .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.
- .4 Definitions:
 - .1 **Commissioning (aka commissioning process)** — a systematic verification, documentation and training process applied to all activities during the design, construction, static verification, start up and functional performance testing, of equipment and systems in a facility to ensure that the facility operates in conformity with the owners project requirements and the basis of design in accordance with the contract documents.
 - .1 **Commissioning Authority** — DCC has been directed by the owner to be their representative to ensure that the GC completes and documents all systems testing and commissioning.
 - .2 **Commissioning check sheets** — the forms used to document the inspections, tests, etc. performed during the commissioning process.

- .3 **Commissioning Provider** — a qualified individual or company responsible for planning, coordinating, and carrying out the commissioning process.
- .2 **DCC Representative**— an individual who provides specialized resources and skills.
- .3 **Contractor** — an individual or company that enters into a contract with the DCC Representative to undertake a project.
- .4 **Control system** — a local system that controls the operation of a stand-alone mechanical system or mechanical equipment. A control system comprises controlled devices (e.g., valves), controlling devices (e.g., thermostats), control wiring, a power supply, and a control air system (i.e., pneumatics).
- .5 **Designer** — any special DCC Representative who is involved in the planning and design process.
- .6 **Design intent** — the performance that a design is intended to achieve in order to meet the Terms of Reference and basis of design. This master plan for the systems is sometimes referred to as the design concept. The design intent is recorded in a design intent manual and guides the preparation of the contract documents. The design intent documentation should cover the following, for each system, major component, facility and area:
 - .1 General system description
 - .2 Objectives and functional use of the system, equipment or facility
 - .3 General quality of materials and construction
 - .4 Occupancy requirements
 - .5 Indoor environmental quality, IEQ (space temperature, relative humidity, indoor air quality, noise level, illumination level, etc.)
- .7 **Functional Performance Testing** – a full range of tests under actual load, conducted to verify specific systems, subsystems, components, and interfaces between systems that conform to a given criteria. These tests are typically used to verify that a sequence of operations is correctly implemented and that the design intent has been met. They are typically done after equipment is placed in full operation.
- .8 **Inspection** — a service traditionally provided as part of the normal scope of a designer’s work. Inspection includes a review of building systems and equipment, or parts thereof.
- .9 **Integration** - Making diverse components and building systems work together under all potential operating conditions
- .10 **Maintenance and data manual** — a detailed document that provides the operating and maintenance requirements and associated data for the safe and efficient operation of specific pieces of equipment and systems.
- .11 **Optimization** — adjusting the building systems to run smoothly and operate in the most effective and efficient condition when a facility is being used as intended
- .12 **Owner** – the entity that represents the interests of the facility, which may include private sector, public sector and quasi-public sector (i.e. Universities, colleges, institutions)
- .13 **Testing agency** — a regulatory authority or other agency, individual, or contractor authorized and/or charged by a facility owner, designer, or contractor with the responsibility for carrying out Functional performance testing and/or verification of building systems and equipment, or parts thereof.
- .14 **Mock up** – A model, either full size or to scale, of a construction system or assembly used to analyze construction details, strength, appearance, functionality and performance. It can be built on site as part of the finished work or in a shop environment.
- .15 **Commissioning Authority:**

- .1 Will be an independent third party hired by the Project Manager who witnesses all systems testing and operation after completion
- .16 **Commissioning Team:**
 - .1 The individuals who through coordinated actions are responsible for implementing the Commissioning Process. (Ex DND PM, DND Design Team, DCC Construction Manager, Commissioning Authority, General Contractor or representative, General Sub Contractors, DND CE Representative and DCC Representative.
- .17 **Data Sheet**
 - .1 Pre-start-up checklist, refer to the manufacture for start- up and warranty documents if not available DCC will supply on request from the GC of the project. These sheets are provided by the CxA and completed by the Contractor. The CxA and DND may jointly approve a substitute form.
- .18 **Test Procedure**
 - .1 A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. This documentation required by the construction sub trades responsible for testing of supplied and installed equipment as per the commissioning plan and specification.
- .19 **Validate**
 - .1 For start-up and performance testing: to witness and confirm proper and complete performance testing and record all deficiencies and report to DCC Representative; when the instructed corrections have been completed re-validate all the deficiencies; and to provide full and detailed documentation for the DCC review and DCC Representative certification.
- .20 **Verify**
 - .1 The CxA's witnessing of the specified performance tests. The contractor shall attend all verifications, and record all deficiencies to be handed out to the CxA for inclusion in final Cx report.

1.3 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per DCC Representative's requirements or determined by designer. To meet Project functional and operational requirements.

1.4 COMMISSIONING OVERVIEW

- .1 Section 01 91 13.13 - Commissioning Plan.
- .2 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 DCC Representative will issue Substantial completion when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by DCC Representative
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by DCC Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.6 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to DCC Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.

- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, subsystems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to DCC Representative.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to DCC Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform DCC Representative in writing of discrepancies and deficiencies on finished works.

1.7 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to DCC Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to DCC Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to DCC Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by DCC Representative.

1.9 COMMISSIONING DOCUMENTATION

- .1 DCC Representative to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to DCC Representative.

1.10 SUBMITTALS

- .1 Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.

- .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Qualified Cx Co-ordinator.
 - .2 Request of any documentation required or review for testing and start-up requirements
 - .3 Preliminary Cx Schedule.
- .2 The Contractor shall provide the CxA- DND with one copy of the shop drawings and all other submittals related to the system stated in the Cx Plan.
- .3 Prior to performance testing, provide copies of related documentation as may be required by the CxA, including, but not limited to, signed certificates, factory test data, start-up sheets, contractor's Cx data, and completed Cx forms.

1.11 WARRANTY

- .1 The involvement of the CxA shall not void any guarantees or warranties nor shall it relieve the Contractor or DCC Representative out of any contractual responsibilities.

1.12 COMMISSIONING PLAN

- .1 The Contractor will be responsible to compile all testing and start-up documentation complete electronic version and in binder form.
- .2 The contractor is responsible to ensure that all documentation has been signed by all parties involved with the start-up and dynamic commissioning of the systems installed under the contract documents.

1.13 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) and 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.
- .3 This schedule should be reviewed at each Cx meeting by the CxA, Contractor and their sub trades, and owner representatives to ensure the proper time is allowed so commissioning milestone can successfully be achieved prior to occupancy.

1.14 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) and 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) and 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart. DCC Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.15 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.16 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 DCC Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.17 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by DCC Representative.
 - .3 Arrange for DCC Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from DCC Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with DCC Representative
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.

1.18 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved 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 finetuning.
- .3 Correct deficiencies and obtain approval from DCC Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require 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 DCC Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by DCC Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by DCC Representative.
 - .3 If evaluation report concludes that major damage has occurred, DCC Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.19 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to DCC Representative for approval before commencement of 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 check lists.

- .4 Start-up reports,
- .5 Step-by-step description of complete start-up procedures, to permit DCC Representative to repeat start-up at any time.

1.20 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit DCC Representative for approval 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 substantial completion.

1.21 TEST RESULTS

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

1.22 START OF COMMISSIONING

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

1.23 INSTRUMENTS / EQUIPMENT

- .1 Submit to DCC Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.24 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
 - .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 EMCS trending to be available as supporting documentation for performance verification.

1.25 WITNESSING COMMISSIONING

- .1 DCC Representative to witness activities and verify results.

1.26 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to DCC Representative within 5 days of test and with Cx report.

1.27 COMMISSIONING CONSTRAINTS

- .1 Since access into secure areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Substantial Completion, using, if necessary, simulated thermal loads.

1.28 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near design conditions, extrapolate part-load results to design conditions when approved by DCC Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.29 EXTENT OF VERIFICATION

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

1.30 REPEAT VERIFICATIONS

- .1 Assume costs incurred by DCC Representative for third and subsequent verifications where:

- .1 Verification of reported results fail to receive DCC Representative's approval.
- .2 Repetition of second verification again fails to receive approval.
- .3 DCC Representative deems Contractor's request for second verification was premature.

1.31 SUNDRY CHECKS AND ADJUSTMENTS

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

1.32 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of DCC Representative.
- .2 Report problems, faults or defects affecting Cx to DCC Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from DCC Representative.

1.33 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.

1.34 TRAINING

- .1 In accordance with Section 01 79 00 - Demonstration and Training.

1.35 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.36 OCCUPANCY

- .1 Cooperate fully with DCC Representative during stages of acceptance and occupancy of facility.

1.37 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with DCC Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data, provided that sensor calibration has been completed and accepted.

1.38 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to 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 to be within +/- 2 % of recorded values.

1.39 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by DCC Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

1.40 COMMISSIONING PROCESS

- .1 The commissioning of the works shall consist of the following as a minimum, supplemented as detailed in individual specification sections and by the requirements of the equipment manufacturer and the commissioning agent's commissioning plan.
- .2 System verifications, equipment startups and whole system functional performance testing for the various systems including:
 - .1 HVAC equipment, exhaust fans, pumps and motors.
 - .2 Generating Set and Transfer Switch
 - .3 Pad mount transformer, service entrance switchboard, distribution panels and feeders.
- .3 Perform demonstration and operator training of complete system, using the completed operation and maintenance manual. Training to identify:
 - .1 Equipment operation
 - .2 Manufacturer-recommended maintenance activities and frequency of maintenance for equipment
 - .3 Spare parts

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

CMMS Equipment Inventory Data Sheet		
PART 1	System Equipment	Component
GENERAL INFORMATION		
Equipment Description		Life Support
		Yes No
Area Served:	Area:	Room #:
PART 2		
MANUFACTURER INFORMATION		Manufacturer Name:
Model Number:		Serial Number:
Local Agent Name:		Phone #: Fax #:
Local Agent Address:		
PART 3		
WARRANTY INFORMATION		Start End Date:
Date:		
Special Warranty Terms and Conditions:		
PART 4		
EQUIPMENT DETAILS		
<i>Electrical Specifications</i>		<i>Mechanical Specifications</i>
Horsepower:		Belts:
Voltage:		Sheaves:
Ampacity:		Pre-Filter Specs:
Phase:		Final Filter Specs:
Frame:		Bearing (front/left)
Service Factor:		Bearing (back/right)
OTHER INFORMATION:		

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Provide a fully functional system:
 - .1 Systems, equipment, and components meet user's functional requirements before date of acceptance and operate consistently at peak efficiencies, and within specified energy budgets under normal loads.
 - .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this Section means "Commissioning".
- .3 Use this Cx Plan as Master Planning Document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process, and administration of Cx.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.
 - .7 WHMIS Safety Data Sheets (SDS).
 - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: Short-term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.2 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed within eight (12) weeks of award of Contract to consider:

- .1 Approved Shop Drawings and product data.
- .2 Approved changes to Contract.
- .3 Contractor's project schedule.
- .4 Cx schedule.
- .5 Contractor's, sub-contractor's, and suppliers' requirements.
- .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to DCC Representative and obtain written approval.

1.3 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from DCC Representative program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update every 2 months during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to DCC Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.4 COMPOSITION, ROLES, AND RESPONSIBILITIES OF CX TEAM

- .1 DCC Representative to maintain overall responsibility for project and is sole point of contact between members of Cx team.
- .2 Project Manager will select Cx Team consisting of following members:
 - .1 DCC Representative is responsible for:
 - .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Witnessing, certifying accuracy of reported results.
 - .4 Witnessing and certifying TAB and other tests.
 - .5 Developing BMM.
 - .6 Ensuring implementation of final Cx Plan.
 - .7 Implementation of Training Plan.
 - .2 Construction Team: Contractor, subcontractors, suppliers, and support disciplines, are responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one (1) person as point of contact with DCC Representative for administrative and coordination purposes.
 - .3 Contractor's Cx agent implements specified Cx activities including:
 - .1 Monitoring operations Cx activities.
 - .2 Performing verification of performance of installed systems and equipment.

- .3 Demonstrations.
- .4 Training.
- .5 Testing.
- .6 Preparation, submission of test reports.
- .4 Property Manager: Represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.5 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation Contractor/Subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment Manufacturer: Equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist Subcontractor: Equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx Agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to DCC Representative's program but are outside scope or expertise of Cx specialists on this project.
 - .5 DCC Representative: Responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete Work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
 - .7 Provide names of participants to DCC Representative and details of instruments and procedures to be followed for Cx three (3) months prior to starting date of Cx for review and approval.

1.6 EXTENT OF CX

- .1 Cx Structural and Architectural Systems:
 - .1 Architectural and structural:
 - .1 Doors, windows, related hardware:

- .1 new door and window hardware.
- .2 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Regular sanitary waste systems.
 - .2 Sump pumps.
 - .2 HVAC and exhaust systems:
 - .1 Exhaust systems and related systems.
 - .3 Fire and life safety systems:
 - .1 Special fire suppression systems identified herein:
 - .1 Wet pipe sprinkler systems.
 - .4 Seismic restraint and control measures for suspended mechanical equipment
 - .5 Energy metering systems for electricity.
- .3 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .2 Emergency power generation systems:
 - .1 Generators.
 - .2 Fuel systems.
 - .3 Transfer switchgear and controllers.
 - .3 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire alarm systems, equipment:
 - .1 Fire Detection and Alarm Annunciation Devices.

1.7 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General Requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools, and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 WHMIS Safety Data Sheets (SDS).
 - .7 Electrical panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.8 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing, and Cx requirements, conditions for acceptance and specifications form part of relevant technical Sections of these Specifications.
- .2 Definitions:
 - .1 Cx as used in this Section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: Provide:
 - .1 Cx Specifications.
 - .1 Startup, pre-Cx activities, and documentation for systems and equipment.
 - .2 Completed installation checklists (ICL).
 - .3 Completed Product Information (PI) report forms.
 - .4 Completed Performance Verification (PV) report forms.
 - .5 Results of Performance Verification Tests and Inspections.
 - .6 Description of Cx activities and documentation.
 - .7 Description of Cx of integrated systems and documentation.
 - .8 Tests of following witnessed by DCC Representative:
 - .9 Tests performed by DCC Representative.
 - .10 Training Plans.
 - .11 Cx Reports.
 - .12 Prescribed activities during warranty period.
- .4 DCC Representative to witness and certify tests and reports of results provided to DCC Representative.
- .5 DCC Representative to participate.

1.9 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: By DCC Representative prior to permission to start-up and rectification of deficiencies to DCC Representative's satisfaction;
 - .2 DCC Representative to use approved checklists;
 - .3 DCC Representative will monitor all pre-start-up inspections;
 - .4 Include completed documentation with Cx report;
 - .5 Conduct pre-start-up tests: Conduct pressure, static, flushing, cleaning, and "bumping" during construction, as specified in Technical Sections. To be witnessed and certified by DCC Representative and does not form part of Cx specifications;
 - .6 DCC Representative will monitor some of these inspections and tests;
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
 - .1 Doors, windows, related hardware:

- .1 Door and window hardware.
- .2 Pre-Cx activities - MECHANICAL:
 - .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .2 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by DCC Representative.
- .3 Pre-Cx activities - LIFE SAFETY SYSTEMS
 - .1 Include equipment and systems identified above.
 - .1 Reports of test results to be witnessed and certified by DCC Representative before verification.
- .4 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre-energization and post-energization tests.
 - .2 Emergency power generation systems
 - .1 Transfer switches: test by simulating loss of power. Verify availability of power at equipment requiring same.
 - .3 Lighting systems:
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
 - .4 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification of new equipment in accordance with ULC requirements. DCC Representative has witnessed and certified report, demonstrate devices and zones to DCC Representative.

1.10 START-UP

- .1 Start up components, equipment, and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment and systems:
- .3 DCC Representative to monitor all start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of DCC Representative.
- .4 Performance Verification (PV):

- .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to DCC Representative.
- .2 Use procedures modified generic procedures to suit project requirements.
- .3 DCC Representative to witness and certify reported results using approved PI and PV forms.
- .4 DCC Representative to approve completed PV reports and provide to DCC Representative.
- .5 DCC Representative reserves right to verify up to 100% of reported results at random.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

1.11 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by DCC Representative and approved by DCC Representative.
- .2 DCC Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 DCC Representative to witness, certify reported results of Cx activities, and forward to DCC Representative.
- .5 DCC Representative reserves right to verify a percentage of reported results at no cost to Contract.

1.12 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed and approved by DCC Representative.
- .2 Tests to be witnessed by DCC Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by DCC Representative, and submitted to DCC Representative for review.
- .4 DCC Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
 - .1 Fire alarm systems:
 - .2 Emergency power generator:
 - .3 Transfer switch and controllers:
 - .4 Emergency lighting systems:
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance DCC Representative, Contractor, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to DCC Representative in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.13 DELIVERABLES RELATING TO ADMINISTRATION OF CX

- .1 General:

- .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.14 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to DCC Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
 - .3 Cx agents' credentials: 60 days before start of Cx.
 - .4 Cx procedures: 3 months after award of contract.
 - .5 Cx Report format: 3 months after contract award.
 - .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
 - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .8 Notification of intention to start TAB: 21 days before start of TAB.
 - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .10 Notification of intention to start Cx: 14 days before start of Cx.
 - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
 - .12 Identification of deferred Cx.
 - .13 Implementation of training plans.
 - .14 Cx reports: immediately upon successful completion of Cx.
 - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx agent, and DCC Representative will monitor progress of Cx against this schedule.

1.15 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by DCC Representative to DCC Representative who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by DCC Representative.

1.16 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Substantial Completion, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.
 - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

.3 Full-scale emergency evacuation exercises.

1.17 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of DCC Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

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 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 REFERENCES

- .1 Definitions:
 - .1 Demolition: rapid destruction of building/structures following removal of hazardous materials.
 - .2 Hazardous Materials: 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 well being or environment if handled improperly.
- .2 Reference Standards:
 - .1 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.
 - .3 Ontario Water Resources Act
 - .1 R.R.O. 1990, Regulation 903, Wells

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: meet project timelines without compromising specified minimum rates of material diversion.
 - .1 Notify DCC Representative in writing when unforeseen delays occur.
- .2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Hazardous Materials:
 - .1 Provide description of Hazardous Materials and Notification of Filing with proper authorities if and as required.
- .2 Submit to DCC Representative for approval a detailed work plan describing the proposed approach, methodology and staging for all abandoned work prior to performing the work.

1.5 SITE CONDITIONS

- .1 Site Environmental Requirements.
 - .1 Provide a sediment and erosion control plan and perform work in accordance with Section 01 35 43 - Environmental Protection.

- .2 Ensure that selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .3 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout the project.
- .4 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances as directed by the DCC Representative.

1.6 EXISTING CONDITIONS

- .1 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify DCC Representative. Hazardous materials will be removed under a separate contract or as a change to the Work.
- .2 If material resembling spray or trowel applied asbestos or other designated substance be encountered in course of demolition, stop work, take preventative measures, and notify DCC Representative immediately. Proceed only after receipt of written instructions have been received from DCC Representative.

Part 2 Products

2.1 EQUIPMENT

- .1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 EXAMINATION

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of selective site demolition required.
- .2 There is no guarantee that existing conditions are the same as those indicated in Contract Drawings
- .3 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element and inform the DCC Representative.

3.2 PREPARATION

- .1 Inspect site with DCC Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage, and items to remain.
- .2 Protection of in-place conditions:
 - .1 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

- .2 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, and adjacent grades.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by DCC Representative.
- .3 Support affected site elements and, if safety of site element being demolished or services appears to be endangered, take preventative measures, stop Work and immediately notify DCC Representative.
- .4 Prevent debris from blocking surface drainage system, mechanical and electrical systems which must remain in operation.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Disconnect and re-route electrical and service lines within the site to be demolished.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of selective site demolition.
- .5 Disconnect and Cap Designated Mechanical Services.
 - .1 Sewer and Water Lines: remove as indicated and securely plug to form watertight seal.
 - .2 Natural gas supply lines: remove in accordance with gas company requirements.
 - .3 Other underground services: remove and dispose of as indicated.
- .6 Disruption of active or energized utilities designated to remain undisturbed is not permitted.

3.3 REMOVAL OPERATIONS

- .1 Remove items as indicated.
- .2 Do not disturb items designated to remain in place.
- .3 Removal of pavements, sidewalks, curbs, and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by DCC Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.
 - .4 Curb removal includes entrance curbs.
- .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving, in accordance with Section 02 41 13.13 - Paving Removal.
- .5 Excavate at least 150 mm below pipe invert, when removing pipes under existing or future pavement area.
- .6 Salvage:
 - .1 Coordinate with the DCC Representative and the Consultant for items to be salvaged.
 - .2 Dismantle items containing materials for salvage and stockpile salvaged materials at locations as determined by the DCC Representative.
- .7 Disposal of Material:

- .1 Dispose of materials not designated for salvage or reuse off the property at an approved waste facility.
- .8 Backfill:
 - .1 Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .9 Abandoning structures:
 - .1 Abandon structures where indicated.
 - .2 Structures that are to be abandoned shall include the partial removal of structures. Such partial removal, when within the roadway, shall be to a minimum of 1.0 m below subgrade.
 - .3 Prior to backfilling, the bottom of each structure designated for partial removal shall be broken to allow for the free movement of groundwater.
 - .4 As an alternative to partial removal, structures may be removed in their entirety at no extra cost.
- .10 Abandoning Pipes:
 - .1 Abandon pipes where indicated.
 - .2 Abandoned sections of pipes up to 1,200 mm in diameter shall be filled with grout or concrete.
 - .1 Concrete and grout for abandoning pipes to be in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .3 Fill the entirety of the abandoned section of pipe with concrete or grout. Contractor must demonstrate to the DCC Representative that the entire pipe has been filled.
 - .4 When abandoned pipes enter into a structure that is to remain, the openings in the structure shall be sealed with concrete. Concrete seals shall be the minimum thickness of the structure wall.
 - .1 Concrete for concrete seals to be in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .5 Refer to mechanical drawing 410.
 - .1 Underground sanitary drains serving two (2) trench drains will be cut and capped (i.e., abandoned in place).
 - .6 Refer to electrical drawings 502, 503 and 506 for underground electrical ducts and ducts that enter a structure that will be abandoned in place

3.4 STOCKPILING

- .1 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.
- .2 Protect stockpiled materials from weather elements as necessary.

3.5 REMOVAL FROM SITE

- .1 Remove stockpiled material as directed by DCC Representative, when it interferes with operations of project.

- .2 Dispose of materials not designated for alternate disposal off Garrison property in accordance with applicable regulations.

3.6 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work.
 - .3 Use cleaning solutions 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 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.8 PROTECTION

- .1 Repair damage to adjacent materials or property caused by selective site demolition, at no cost to DCC Representative or Owner.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition

1.2 REFERENCE STANDARDS

- .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
- .2 Canadian Environmental Protection Act, 1999 (CEPA), c. 33.

1.3 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 DCC Representative and at no additional cost:
 - .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 Protect existing site features and structures, trees, plants and foliage on site and adjacent properties.

Part 2 Products

2.1 EQUIPMENT

- .1 Asphalt can be removed utilizing cold milling, planning, grinding or excavation equipment, with the capability 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 a sediment and erosion control plan as per Section 01 35 43 - Environmental Protection
- .4 Prior to beginning removal operation, inspect and verify with DCC Representative areas, depths and lines of asphalt pavement to be removed.
- .5 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 DCC Representative at no additional cost to DCC or the Owner.

3.2 REMOVAL

- .1 Remove existing asphalt pavement to lines and grades as indicated, and as required in order to perform trenching and underground works. Saw cut along limit of asphalt to be removed.
 - .1 Where there is one (1) lift of asphalt, the existing pavement shall be saw cut to provide a proper butt joint.
 - .2 Where there is two (2) or more lifts of asphalt, each upper course of asphalt shall be stepped back 500mm from the lower joint.
- .2 Demolition of pavements:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method acceptable to DCC 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.
 - .5 Step asphalt pavement adjacent to asphalt is to remain and where indicated
- .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 to be within +/-10 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 & Waste Management.
 - .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 & Waste Management.
- .3 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-place Concrete.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/ Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86-14, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
 - .3 CSA O121-17, Douglas Fir Plywood.
 - .4 CSA S269.1-16, Falsework for Construction Purposes.
 - .5 CAN/CSA-S269.3-16, Concrete Formwork, National Standard of Canada
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121. Use new materials throughout except for concrete in unexposed locations such as foundations where used material is acceptable. Fabricate all forms from sound, undamaged sheets with clean true edges, sealed and factory treated with form sealer. Thicknesses as required to support concrete at rate poured with no bowing of forms between supports. If forms are not new, obtain approval before using.
 - .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.
- .2 Form ties:
 - .1 For concrete not designated 'Architectural' or concealed conditions, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
 - .3 Wire ties and wood spacers not permitted.
- .3 Form liner:
 - .1 Plywood: high density overlay Douglas Fir to CSA O121, square edge, 19mm thick.

- .4 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps, preventing concrete from sticking to forms, non-toxic, biodegradable, low VOC.
- .5 Falsework materials: to CSA-S269.1.
- .6 Joint tape for sealing panel joints: Tape must be capable of preventing leakage of concrete in form joints.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain DCC Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .6 Align form joints and make watertight, keep form joints to minimum.
- .7 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .10 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .11 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 48 hours for curbs and sidewalks.

- .2 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .3 Take particular care when removing forms to ensure no damage occurs at corners and arises.
- .4 Space reshoring in each principal direction at not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00: Concrete Forming and Accessories.
- .2 Section 03 30 00: Cast-in-Place Concrete.

1.2 REFERENCES

- .1 All referenced standards shall be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.
- .2 Canadian Standards Association (CSA International):
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A23.3, Design of Concrete Structures.
 - .3 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 Reinforcing Steel Institute of Canada (RSIC):
 - .1 Reinforcing Steel Manual of Standard Practice.
- .4 American Concrete Institute (ACI):
 - .1 SP-66, ACI Detailing Manual.
- .5 ASTM International Inc.:
 - .1 ASTM A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - .2 ASTM A1044 / A1044M, Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.

1.3 QUALITY ASSURANCE

- .1 In accordance with Section 01 45 00 – Quality Control.

1.4 QUALITY CONTROL

- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .2 Source Quality Control Submittals:
 - .1 Upon request, provide DCC Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
 - .2 Upon request, inform DCC Representative of proposed source of reinforcement material to be supplied.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's data sheets for mechanical rebar splices.
- .3 Shop Drawings:
 - .1 Prepare shop drawings in accordance with RSIC Manual of Standard Practice unless the Contract Documents contain a more stringent requirement. Conform to ACI SP-66 Detailing Manual whenever a detail condition is not covered by any of the above.
 - .2 Submit plans, elevations, sections and details necessary to fabricate, place and review reinforcement without reference to structural drawings, including masonry wall reinforcement. Draw to scale not smaller than 1:50 ($\frac{1}{4}" = 1'-0"$).
 - .3 Show on drawings:
 - .1 Sizes, spacings and locations of reinforcement, with identifying labels.
 - .2 Bar bending details.
 - .3 Lengths of all lap splices.
 - .4 Types and locations of mechanical splices.
 - .5 Bar lists.
 - .6 Quantities of reinforcement (including all rebars added to accommodate installation).
 - .7 Construction joint, control joint and pour gap locations.
 - .8 Strip dimensions for flat slab and flat plate.
 - .9 Concrete cover.
 - .4 Do not release for fabrication reinforcing bars whose length may be affected by field conditions, such as the final elevation of footings, until obtaining the required field measurements.

Part 2 Products

2.1 MATERIALS

- .1 Reinforcing steel: carbon steel, deformed bars to CSA G30.18., unless indicated otherwise.
- .2 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.
- .3 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .4 Welded steel wire fabric: to ASTM A185/A185M. Provide in flat sheets only.
- .5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .6 Plain round bars: to CSA G40.20/G40.21.

Part 3 Execution

3.1 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice.
 - .1 Ship bundles of bar reinforcement, clearly identified in accordance with bar lists.
 - .2 Provide standard hooks at ends of all hooked bars.
 - .3 Substitute different size bars only if permitted in writing by the DCC Representative.

3.2 FIELD BENDING

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

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1/A23.2.
 - .1 Remove all loose scale, dirt, oil or other coatings which would reduce bond.
 - .2 Ensure cover to reinforcement is maintained during concrete pour.
 - .3 Turn ends of tie wire towards the interior of concrete.
 - .4 Use bar supports for beams and slabs.
 - .5 Use precast concrete chairs where supports rest on the ground. Where welded wire fabric is used in slabs-on- grade, place precast concrete chairs at 600 mm (2'-0") on centre each way.
 - .6 Use side form spacers for walls and columns.
 - .7 Do not splice reinforcing at locations other than shown on placing drawings without DCC Representative's written approval.
 - .8 Do not cut reinforcement without DCC Representative's written approval.
 - .9 Exposed concrete surfaces:
 - .1 Use plastic or plastic tipped bar supports and spacer with colour to match concrete.
 - .10 Do not field weld reinforcement except where indicated or authorized by the DCC Representative.
 - .11 Slip dowels:
 - .1 Use plain round bars.
 - .12 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
 - .13 When paint is dry, apply thick even film of mineral lubricating grease.

3.4 FIELD QUALITY CONTROL

- .1 Refer to Section 01 45 00 – Quality Control.
 - .1 Bring to the attention of the DCC Representative any defects or deficiencies in the work together with a proposal for remedy. The DCC Representative will decide what corrective action may be taken, and will issue the necessary instructions.
 - .2 Construction Review:
 - .1 General review during construction by the DCC Representative will be carried out by examination of representative samples of the work.
 - .2 Do not close forms or pour concrete before reinforcing steel is reviewed.
 - .3 Construction review reports will outline any deficiencies found.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 – Concrete Reinforcing

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C109/C109M-16a, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50 mm Cube Specimens).
 - .2 ASTM C260/C260M-10a (2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C939/C939M-16a, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - .5 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .2 CSA International
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-06 (R2016), Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide copies of WHMIS MSDS in accordance Health and Safety Requirements.
- .2 Submit concrete mix design suitable for intended application.

1.4 QUALITY ASSURANCE

- .1 Certificates:
 - .1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1, and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .2 Obtain each material from same source and maintain high degree of consistency in workmanship throughout Project.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by DCC Representative on following items:
 - .1 Cold weather concrete.
- .4 Quality Control Plan: provide written report to the DCC Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 -

PRODUCTS.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: maximum allowable time limit for concrete to be delivered to site of Work and discharged, not to exceed 120 minutes after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from the DCC Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by the DCC Representative.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.6 SITE CONDITIONS

- .1 Visit site to determine available access, storage and working areas. Determine any interference from existing services.
- .2 Use of accelerating or set retarding admixtures during hot or cold weather concrete placing shall be subject to the DCC Representative's approval.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Use trigger operated spray nozzles for water hoses.
- .2 Designate a cleaning area for tools to limit water use and runoff.
- .3 Carefully coordinate the specified concrete work with weather conditions.
- .4 Ensure emptied containers are sealed and stored safely for disposal, out of reach of children.
- .5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies, streams, or stormwater system. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .6 Choose least harmful, appropriate cleaning method which will perform adequately.

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .1 Ensure that concrete surfaces are dense, even, uniform in colour, texture and distribution of exposed aggregates, free from defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints, excessive bug holes, inadequate cover to reinforcement and incorrect tie holes, spacers, reglets, formwork joints or construction joints.
- .2 Ensure concrete are free from chips and spalls.

2.2 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
- .2 Blended hydraulic cement: Type GUB to CSA A3001.
- .3 Supplementary cementing materials: to CSA A3001.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1/A23.2.
- .6 Obtain coarse and fine aggregate for exposed concrete from the same sources and select from uniformity of colour. Stockpile supplies for project.
- .7 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494. The DCC Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .3 Do not use calcium chloride admixtures.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
- .9 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 35 MPa at 28 days.
- .10 Premoulded joint fillers:
 - .1 12mm thick, bituminous impregnated fibre board: to ASTM D1751.
- .11 Other concrete materials: to CSA A23.1/A23.2.
- .12 Water curing: Water conforming to CSA A23.1, Clause 4, clear and entirely free from any elements which might cause staining of concrete.

2.3 MIXES

- .1 Proportion normal density concrete in accordance with CSA A23.1, to give the following properties for all concrete.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: C-2.
 - .2 Compressive strength at 28 days: 35 MPa minimum.
 - .3 Air Entrainment: 5-8%.
 - .4 Intended application: sidewalks, curb and gutter.
 - .3 Provide quality management plan to ensure verification of concrete quality to specified performance.
 - .4 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

2.4 PRODUCTION

- .1 Use ready-mixed concrete, produced in accordance with CSA A23.1, Clause 5.2.
- .2 Heat concrete and deliver at a temperature conforming to CSA A23.1, Clause 5.2.4.4.

Part 3 Execution

3.1 PREPARATION

- .1 Do not begin operations before making a thorough examination of existing conditions and the work of related trades. Report inconsistencies to the DCC Representative immediately.
- .2 Obtain the DCC Representative 's written approval before placing concrete. Provide the DCC Representative 24 hours minimum notice before each concrete pour.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain the DCC Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by the DCC Representative.
- .11 Confirm surfaces on which concrete is to be placed are free of frost, water and debris before placing concrete.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Concrete Placement:
 - .1 Remove water from excavations before placing concrete.
 - .2 Clean all forms of debris, organic matter, and deleterious materials before placing concrete.
 - .3 Adjust reinforcement immediately before concrete is placed to ensure that all the reinforcement is secured in their correct positions.
 - .4 Use form vibrators for thin sections where rodding, spading or the use of internal vibrators is impractical.

- .5 Do not place concrete in the rain. Protect exposed surfaces from rain or other adverse weather conditions until final set occurs.
- .6 The maximum average time from charging the mixer to final deposit is 60 minutes, the maximum individual time from charging the mixer to final deposit is 90 minutes. Do not add water to the mix.
- .3 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Finishing of the concrete surface shall take place while the concrete is sufficiently plastic to achieve the desired grades, elevations and texture.
 - .3 The surface shall be uniform, dense, free from undulations and projections, struck off true to grade and cross-sections, and finished with a float.
 - .4 Excessive fines and water shall not be drawn to the surface.
 - .5 Use procedures noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .6 Provide curing and protection for concrete to CSA A23.1, Clause 7.4.
 - .7 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .8 Provide and maintain wet curing for five (5) days minimum to any exposed concrete.
 - .9 Protect and cure concrete in such a manner as to prevent evaporation of moisture from the concrete and injury to the surface.
 - .10 When the air temperature may exceed 27°C curing shall be by methods which keep the surface continually moist for at least 7 days after placing, commencing immediately once the concrete has set sufficiently. Moisture shall be applied by fogging or by the application of wetted burlap, or by other acceptable methods which will not damage the surface. A curing membrane is not acceptable under these conditions.
 - .11 When the temperature will not exceed 27 °C a curing membrane specified herein may be used. Membrane curing over slab shall be compatible with finish to be applied. For sidewalks, curbs and similar exterior concrete, use a membrane specified herein.
 - .12 Localized defects shall be repaired using concrete.
 - .13 Shrinkage cracking as a result of improper curing will be cause for rejection of the concrete element in question. The concrete must be removed and replaced at no cost to the DCC Representative.
- .4 Surface Finishing:
 - .1 Broom Finish: Use stiff bristled broom to produce nonslip concrete surface finish approved by the DCC Representative, with fine granular texture free from disfigurements.
 - .2 Texturing to be straight, precise and not damaging to pavement edges.
 - .3 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
 - .4 Geometrical Requirements: 2% slope for drainage to sidewalk and curbs.
- .5 Contraction Joints:
 - .1 Cut and form control joints in sidewalks and curbs to closely match existing conditions.
 - .2 Contraction joints shall be sawcut to a depth that is 0.25 of slab thickness.
- .6 Expansion / Isolation Joints:
 - .1 Furnish filler for each joint in single piece for depth and width required for joint.
 - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form expansion and isolation joints to closely match existing conditions.

- .4 Install premoulded joint filler in expansion and isolation joints to within 6mm of finished surface to CSA A23.1/A23.2.

3.3 COLD WEATHER CONCRETING

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Provide Cold-Weather Concreting when air temperature is $\leq 5^{\circ}\text{C}$ or when there is a probability that the temperature may fall below 5°C within 24 hours of placing the concrete.
- .3 Removing all ice and snow from the subgrade or formwork.
- .4 Supply necessary supplemental heat required to ensure that forms, subgrades, and reinforcing steel is maintained a minimum temperature of 5°C well prior to the concrete placement.
- .5 Chemical admixtures and mix design modifications can be used to offset the slower setting times and strength gain of concrete during cold weather conditions. Considerations should be given to ordering concrete that will obtain higher early strengths.
- .6 Concrete temperature must be maintained at a minimum of 10°C for the full curing period.

3.4 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1 Straightedge Method.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory certified to CSA A283.
- .2 Contractor to coordinate and pay for costs of three (3) concrete compressive test to demonstrate adherence to specified requirements.
- .3 Inspection Company's reports of tests will be forwarded to DCC Representative and Contractor with an opinion or reason for any abnormalities noted thereon.
- .4 Ensure that supervisory personnel are on hand when concrete is cast so that the placing and curing procedures of the specification will be properly observed.
- .5 Immediately cease further concrete placement on advice that concrete already has been rejected by DCC Representative. Replace rejected work in a manner approved by the DCC Representative and at the Contractor's expense. Make good cracking or finish not accepted by the DCC Representative, to their satisfaction, at no additional cost to the DCC Representative.
- .6 Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.
- .7 Inspection or testing by DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.6 CLEANING

- .1 Waste Management: separate waste materials for recycling and reuse.
 - .1 Provide appropriate area on job site where concrete trucks can be safely washed.
 - .2 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.
 - .3 Do not dispose of unused admixtures and additive materials into sewer systems, onto ground or in other location where it will pose health or environmental hazard.
 - .4 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 National Building Code of Canada – Latest Edition.
- .2 American Association of Textile Chemists and Colorists (AATCC):
 - .1 AATCC 127 – 2018, Water resistance: Hydrostatic Pressure Test
- .3 Architectural Woodwork Institute (AWI) / Architectural Woodwork Manufacturers Association of Canada (AWMAC) / Woodwork Institute (WI):
 - .1 AWI/AWMAC/WI Architectural Woodwork Standards (AWS) Section 6 – Millwork.
- .4 ASTM International
 - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM C518 - 17, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - .3 ASTM C1289-16a, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .4 ASTM D1621 - 16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .5 ASTM D2559 - 12a, (2018) Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions
 - .6 ASTM D5055-16, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .7 ASTM D5456-17, Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .8 ASTM E84 – 19, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .9 ASTM E96 / E96M – 16, Standard Test Methods for Water Vapor Transmission of Materials
 - .10 ASTM E2178 – 13, Standard Test Method for Air Permeance of Building Materials
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB - 51.34-M86 - Polyethylene Vapour Barrier
- .6 CSA International
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O121-17, Douglas Fir Plywood.
 - .3 CSA O141-05(R2014), Softwood Lumber.
 - .4 CSA O325-16, Construction Sheathing.
 - .5 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
- .7 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.
- .8 Technical Association of the Pulp and Paper Industry (TAPPI):
 - .1 TAPPI T 410, Grammage of paper and paperboard (weight per unit area)
 - .2 TAPPI T460 om-16, Air resistance of paper (Gurley method)

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada for:
 - .1 wood I-joists including connections and supports

1.2 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location 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 FRAMING STRUCTURAL AND PANEL MATERIALS

- .1 Lumber: softwood, S4S, moisture content S-DRY graded and stamped in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Framing and board lumber: in accordance with NBC, except as follows:
 - .1 Studs: spruce, pine or fir (SPF), 121c. "STUD".
 - .2 Joists, lintels, beams, collar ties, and plates: spruce, pine or fir (SPF), 124b. "No. 1" STRUCTURAL, STRUCTURAL LIGHT FRAMING AND STRUCTURAL JOISTS AND PLANKS.
 - .3 Trusses: spruce, pine or fir (SPF), 124b. "No. 1" 124c. "No. 2" - STRUCTURAL, STRUCTURAL LIGHT FRAMING AND STRUCTURAL JOISTS AND PLANKS.

- .3 Furring, blocking, nailing strips, strapping, grounds, rough bucks, bracing, bridging, cants, curbs, fascia backing and sleepers: NLGA spruce, pine or fir (SPF), 121c.
 - .1 Orientated-strand board (OSB) sheathing panels: to CSA O325, Exposure 1 classification.
 - .2 Fire retardant treated plywood: Douglas Fir to CSA O121, G1S, fire retardant treated to CSA O80.27, maximum flame spread 25, maximum smoke developed 25.
 - .1 Backboard: 19 mm thick, sanded, to Table E-1.
- .4 Polyisocyanurate sheathing: to ASTM C1289, Type I, Class 1:
 - .1 faced each side with aluminum foil.
 - .2 compressive strength minimum 110 kPa to ASTM D1621.
 - .3 thermal resistance: RSI 1.08 (m²•°C/W) per 25.4 mm to ASTM C518.

2.2 ACCESSORIES

- .1 Air seal: closed cell polyurethane or polyethylene.
- .2 Sealants: in accordance with Section 07 92 00.
- .3 Nails, spikes and staples: to CSA B111.
- .4 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .5 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .6 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .7 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .8 Fastener Finishes:
 - .1 Galvanizing: to ASTM A123/A123M, use galvanized fasteners for exterior work.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Apply sill plate gasket over concrete or masonry on which wood framing bears.
- .2 Wood frame construction to National Building Code of Canada 2020, Division B, Part 9.
- .3 Do interior and exterior millwork to AWI/AWMAC/WI AWS Section 6.
- .4 Install members true to line, levels and elevations, square and plumb to a tolerance of 1:600 and rigidly secure in place.
- .5 Construct continuous members from pieces of longest practical length.
- .6 Install spanning members with "crown-edge" up.
- .7 Install weather-resistant barrier sheet material to form continuous layer within the wall assembly. Install tie-in sections where obstacles are encountered. Tape all seams. Tape and seal sheet at abutting materials at the edges of the installation. Install in accordance with manufacturer's instructions.
- .8 Install vapour retarder sheet material to form continuous layer within the wall assembly. Install tie-in sections where obstacles are encountered. Tape all seams. Tape and seal sheet at abutting materials at the edges of the installation. Install in accordance with manufacturer's instructions.
- .9 Install wall sheathing in accordance with manufacturer's printed instructions.
- .10 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .11 Install furring to support metal roof or wall siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing. Align and plumb faces of furring and blocking to tolerance of 1:600.
- .12 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .13 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .14 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

- .15 Countersink bolts where necessary to provide clearance for other work.
- .16 Install plywood backboards with countersunk screws.
- .17 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.
- .18 Secure exterior work with galvanized or non-ferrous fasteners.
- .19 Apply continuous bead of sealant at junction between sill plate and concrete at exterior walls.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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 11.

3.6 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 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork Institute (WI).
 - .1 AWMAC/WI North American Architectural Woodwork Standards (NAAWS) – 3.1.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings.
 - .2 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .3 Indicate materials, thicknesses, finishes and hardware.
 - .4 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .4 Samples: Submit duplicate samples of HPDL and laminated plastic for colour selection.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Protect against dampness and damage during and after delivery.
 - .2 Store in ventilated areas, protected from extreme changes of temperature or humidity.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Sealant: in accordance with Section 07 92 00, type silicone.

2.1 MANUFACTURED UNITS

- .1 Casework:
 - .1 Comply with AWMAC/WI NAAWS Section 10:
 - .1 custom quality grade
 - .2 decorative laminate type, HPDL; Colour selection from the manufacturer's standard options by DCC Representative.
 - .3 frameless construction with flush overlay
 - .4 MDF primary core material
 - .5 square edges with applied edgeband
 - .6 minimum 244 kg/m² shelf capacity
 - .7 minimum 34 kg drawer load capacity
 - .8 Grade 2 hardware
 - .9 European style hinges
 - .1 full drawer extension
 - .2 shelving adjustable
 - .3 D pulls – 76 mm centre to centre
 - .2 Countertops:
 - .1 Comply with AWMAC/WI NAAWS Section 11:
 - .1 custom grade
 - .2 post formed HPDL type
 - .3 MDF primary core material minimum 19 mm thick
 - .4 no drip edge with coved splash, complete with end-splash at flanking partitions
 - .5 colour to later selection from the manufacturer's standard patterns

2.2 FABRICATION

- .1 Fabricate casework to AWMAC/WI NAAWS Section 10.
- .2 Fabricate countertops to AWMAC/WI NAAWS Section 11.
- .3 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .4 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .5 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install casework to AWMAC/WI NAAWS Section 10.
- .2 Install countertops to AWMAC/WI NAAWS Section 11.
- .3 Install casework and countertops at locations shown on drawings. Position accurately, level, plumb straight.
- .4 Fasten and anchor casework and countertops securely. Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .5 Use draw bolts in countertop joints.
- .6 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .7 At junction of countertop back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00.
- .8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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 11.
 - .1 Clean casework and countertops.
 - .2 Remove excess glue from surfaces.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect casework and countertops from damage until final inspection.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA Group:
 - .1 CSA B149 Series-15, Consists of B149.1-15, Natural Gas and Propane Installation Code and B149.2-15, Propane Storage and Handling Code.
- .2 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-S604-M91, Standard for Factory-Built Type A Chimneys.
 - .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
 - .4 CAN/ULC-S704-11, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location 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 INSULATION

- .1 Extruded polystyrene (XPS): to CAN/ULC-S701.
 - .1 Type: 4.
 - .2 Compressive strength: 207 kPa.
 - .3 Thickness: as indicated.
 - .4 Size: 609 X 2438 mm.
 - .5 Edges: square.

- .2 Polyisocyanurate (Faced): to CAN/ULC-S704
 - .1 Type 1, Class 1.
 - .2 Core: rigid cellular polyisocyanurate.
 - .3 Face surfaces, front and back: laminated aluminum foil.
 - .4 Shape: flat.
 - .5 Thickness: as indicated.
 - .6 Size: 1219 X 2438 mm.
 - .7 Edges: square.
 - .8 Flame spread <500 to CAN/ULC S102.

2.2 TAPE FOR POLYISOCYNARATE BOARD

- .1 Self-adhering, roll tape, effective as air and vapour barrier: as recommended by manufacturer of polyisocyanurate board insulation:
 - .1 Width: minimum 76 mm.
 - .2 Thickness: minimum 0.636 mm.

2.3 ACCESSORIES

- .1 Fasteners for extruded polystyrene to foundation walls: corrosion-resistant fastener with 25 mm diameter head, length to suit insulation and penetrate minimum 38 mm into concrete foundation wall.
- .2 Fasteners for polyisocyanurate to wall or roof framing: screws, minimum size #8, length to suit insulation and penetrate minimum 19 mm into wood framing, and with a plastic or metal washer/plate with a minimum diameter of 25 mm.

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 board insulation application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install in accordance with insulation manufacturer's written recommendations.
- .2 Install insulation after building substrate materials are dry.
- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions. Gaps greater than 6 mm to be filled with similar insulating material.

- .5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CSA B149.1 and CSA B149.2 type B and L vents.
- .6 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .7 Offset both vertical and horizontal joints in multiple layer applications.
- .8 Do not enclose insulation until it has been inspected and approved by DCC Representative.

3.3 PERIMETER FOUNDATION INSTALLATION

- .1 Foundation wall application: install in interior face, extend extruded polystyrene boards minimum 900 mm vertically below underside of floor slab. Secure each board with 2 fasteners to secure insulation prior to backfilling.
- .2 Under slab application: Lay extruded polystyrene boards on level compacted fill over entire area of slab.

3.4 WALL INSTALLATION

- .1 Install polyisocyanurate board insulation and secure through weather-resistant sheet barrier to OSB sheathing.
- .2 Secure with minimum 12 evenly spaced fasteners per full board.
- .3 Tape all seams between boards to form continuous air barrier.

3.5 ROOF INSTALLATION

- .1 Install polyisocyanurate board insulation and secure through weather-resistant sheet barrier to underside of roof joists.
- .2
- .3 Secure with minimum 12 evenly spaced fasteners per full board.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

END OF SECTION

Construct New Workshop

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C1320-10 (2016), Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .2 CSA Group
 - .1 CSA B149 Package-15, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S604:2016, Standard for Factory-Built Type A Chimneys.
 - .2 CAN/ULC-S702-14, Standard for Mineral Fibre Insulation for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location 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 INSULATION

- .1 Mineral wool batt insulation to CAN/ULC S702:
 - .1 Type 1.
 - .2 Thickness: as indicated.
 - .3 Width: to suit spacing of wood joists/framing members.

2.1 ACCESSORIES

- .1 Mechanical fasteners in accordance with insulation manufacturer's written recommendations.

Construct New Workshop

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 blanket insulation application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSULATION INSTALLATION

- .1 Install insulation in accordance with manufacturer's written recommendations.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .4 Do not compress insulation to fit into spaces.
- .5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys and CSA B149.1 and CSA B149.2 Type B and L vents.
- .6 Do not enclose insulation until it has been inspected and approved by DCC Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

END OF SECTION

Construct New Workshop

Part 1 General

1.1 REFERENCES

- .1 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.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for vapour retarders and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location 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 SHEET VAPOUR RETARDER

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm (6 mil) thick.

2.2 ACCESSORIES

- .1 Joint sealing tape: 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.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

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 DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall and roof assemblies prior to 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 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

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 minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.6 ELECTRICAL BOXES

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
 - .1 Install moulded box vapour barrier.
 - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

END OF SECTION

Construct New Workshop

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A792 / A792M – 10 (2015), Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-93.5-92, Installation of Metal Residential Siding, Soffits and Fascia.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings: Submit shop drawings. Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring, and related work.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal siding from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 STEEL SIDING

- .1 Siding: Preformed panels to match existing.

Construct New Workshop

2.2 FASTENERS

- .1 Screws: 6 mm hex head with neoprene washer, colour matched to siding colour, length to suit wall assembly and penetrate minimum 19 mm into wood furring.

2.3 CAULKING

- .1 Sealants: in accordance with Section 07 92 00. Colour to match siding colour.

2.4 ACCESSORIES

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, thickness and colour as siding, with fastener holes pre-punched.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 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.

3.3 INSTALLATION

- .1 Install cladding in accordance with CAN/CGSB-93.5, and manufacturer's written instructions.
- .2 Install 19 X 64 mm wood furring at 406 mm OC and as required to align with siding fastener spacing.
- .3 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.
- .4 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .5 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .6 Attach components in manner not restricting thermal movement.
- .7 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00.

Construct New Workshop

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A792/A792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
- .2 UL LLC:
 - .1 UL 580, Standard for Tests for Uplift Resistance of Roof Assemblies

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings: Submit shop drawings. Indicate dimensions, profiles, attachment methods, trim and closure pieces, soffits, fascia, metal furring, and related work. Shop Drawings shall be signed and sealed by an Ontario Professional Engineer, attesting to the ability of the assembly to withstand the specified loads.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal siding from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 DESIGN REQUIREMENTS

- .1 Design roof system to resist:
 - .1 Snow loads and snow build-up and rain load, expected in this geographical region NBCC climatic data, 50 year probability: 2.08 kPa.
 - .2 Wind loads, positive and negative, expected in this geographical region NBCC climatic data, 50 year probability: 0.41 kPa.
 - .3 Dead load of roof system.

- .2 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

- .1 Temperature Change (Range): 20 degrees C, ambient; 40 degrees C, material surfaces.

1.6 WIND REQUIREMENTS

- .1 The roof panel installation shall be UL-90 class rated in accordance with UL 580.

Part 2 Products

2.1 STEEL ROOFING

- .1 Galvanized roofing: preformed panels
 - .1 material: AZM150 Galvalume sheet steel to ASTM A792M Grade 340
 - .2 profile: interlocking design for mechanically seamed joint, 69 mm depth
 - .3 width: 610 mm
 - .4 material thickness: 0.61 mm minimum
- .2 Clip and Fastening System: Clip, minimum 190 mm long, purpose-made, sliding clip designed to accommodate expansion and contraction of the roof sheet. Made from galvanized material, thickness to suit design parameters complete with thermal blocks between clips.
- .3 Fasteners: As recommended by manufacturer, to resist wind uplift and sliding snow forces.

2.2 ACCESSORIES

- .1 Flashing: In accordance with Section 07 62 00. Formed from same materials as the roof panels. Custom fabricated to suit architectural details.
- .2 Closures: Foam and metal closures to suit profiles selected and maintain weather-tightness, to manufacturer's recommendations.
- .3 Sealants: In accordance with manufacturer's recommendation and Section 07 92 00.
- .4 Continuous ridge vent: Continuous metal providing 0.06 m² of opening per 3050 mm of length.
- .5 Eave baffle: Rigid extruded polystyrene attic rafter vent. Size (WxLxD): 571 mm X 1220 mm X 51 mm
- .6 Sheet metal roof membrane:
 - A. Self-Adhering Membrane:
 - 1. Composition: Rubberized asphalt or polymer-modified bitumen laminated to a high-temperature resistant facer.
 - 2. Thickness: Minimum 40 mils.
 - 3. Adhesive: Pressure-sensitive, self-adhering, requiring no mechanical fasteners.
 - 4. Facer: High-strength, slip-resistant, UV-resistant for minimum manufacturer's exposure period.
 - 5. Temperature Rating: Suitable for continuous in-service temperatures up to 240–260°F (115–127°C) or manufacturer's maximum.
 - 6. Standards: Meets or exceeds ASTM D1970 including:
 - a. Self-sealability around fasteners.

- b. Waterproofing performance.
- c. Low-temperature flexibility.
- B. Primer: As recommended by manufacturer for low-temperature or difficult substrates.

2.3 FABRICATION

- .1 Fabricate roof components to comply with dimensions, profiles, gauges and details as shown on the shop drawings, including fascia and soffit panels and all companion flashing.
- .2 Fabricate all components of the system in the factory, ready for field installation.
- .3 Provide roof sheet and all accessories in longest practicable length to minimize field lapping of joints.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 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.

3.3 INSTALLATION

- .1 Use concealed fastenings except where approved by DCC Representative before installation.
- .2 Install preformed roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure batten is positively locked for full length of roof. Close interlocking side joints by using a purpose-made seaming machine, as supplied by the manufacturer.
- .3 Secure the end-lap of metal roofing sheets in accordance with the manufacturers specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof panel.
- .4 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.
- .5 Install all companion flashing, vent pipe, gutters and ventilators. Use concealed fasteners when possible. Exposed fasteners to match colour of the roof panel.
- .6 Lock all end joints and caulk to provide a weather tight seal. Sealant to match colour of roof panel.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A792/A792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings: Submit shop drawings. Indicate dimensions, profiles, attachment methods, trim and closure pieces, soffits, fascia, metal furring, and related work.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal flashing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SHEET METAL MATERIALS

- .1 Steel Sheet
 - .1 material: AZM150 Galvalume sheet steel to ASTM A792M Grade 340
 - .2 material thickness: 0.61 mm minimum
 - .3 colour: to closely match light grey siding.

2.2 ACCESSORIES

- .1 Sealants: In accordance with manufacturer's recommendation and Section 07 92 00.
- .2 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .3 Fasteners: As recommended by manufacturer, to resist wind uplift and sliding snow forces. Colour to match sheet metal.

2.3 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work as indicated.
- .3 Form pieces in 3050 mm maximum lengths. Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

2.4 METAL FLASHINGS

- .1 Form flashings, copings and fascia to profiles indicated of 0.61 mm thick sheet steel.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 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.

3.3 INSTALLATION

- .1 Use concealed fastenings except where approved by DCC Representative before installation.
- .2 Exposed fasteners to match colour of the roof panel.
- .3 Lock all end joints and caulk to provide a weather tight seal. Sealant to match colour of roof panel.
- .4 Install sheet metal flashing work as detailed.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.4 PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.1 Work Included

- .1 Fire stopping and smoke seals at all penetrations through fire rated wall assemblies for conduit, cables, ductwork, and other building services.

1.2 References

- 1. Underwriter's Laboratories of Canada (ULC)
- 2. ULC-S115-1995, Fire Tests of Firestop Systems.
- 3. Firestop System Components (40 U19.13).

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 10 05 – General Instructions.
- .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.

1.4 Product Data

- .1 Submit product data in accordance with Section 01 10 05 – General Instructions.
- .2 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 56 00 – Environmental Protection and Waste Reduction.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 Materials

- .1 Fire stopping and smoke seal systems: in accordance with ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Firestop system rating: F.
- .2 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No.40 U19.

- .3 Service penetration firestop components: certified by ULC in accordance with ULC-S115 and listed in ULGuide No.40 U19.13 and ULC Guide No.40 U19.15 under the Label Service of ULC.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with Ontario Building Code: 1 hour for walls and 2 hour for floor slabs.
- .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.

PART 3 - EXECUTION

3.1 Preparation

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. 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.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 Installation

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.
- .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 a neat finish.

-
- .5 Remove excess compound promptly as work progresses and upon completion.

3.3 Inspection

- .1 Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.4 Schedule

- .1 Firestop and smoke seal at:
- .1 Penetrations through fire-resistance rated gypsum board partitions and walls.
 - .2 Top of fire-resistance rated partitions.
 - .3 Intersection of fire-resistance rated gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .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 Existing partitions between the Labs and the Public Corridor = 1 hour fire rating
 - .9 Existing floor slabs = 2 hour fire rating.

3.5 Clean Up

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C834-17, Standard Specification for Latex Sealants.
 - .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.21-M87, Sealing and Bedding Compound, Acoustical

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's installation instructions, printed product literature and data sheets for sealants, caulking, primers and include product characteristics, performance criteria, colour charts and limitations.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.5 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5°C.
 - .2 When joint substrates are wet.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Silicone Sealant:
 - .1 High-performance, single-component, moisture-cure, ultralow modulus silicone sealant.
 - .2 To ASTM C920 Type S, Grade NS, Class 100/50, Use NT, M, G, A and O.
- .2 Latex Sealant:
 - .1 Pure acrylic latex sealant formulated to provide a fast-setting pliable seal with minimal shrinkage.
 - .2 To ASTM C834, Type OP, Grade -18 °C
- .3 Acoustical Sealant.
 - .1 Single component, non-skinning, non-hardening synthetic rubber sealant.
 - .2 To CAN/CGSB 19.21 M87.
- .4 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded open or closed cell foam backer rod.
 - .2 Size: oversize 30 to 50%.
 - .2 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

- .1 Unless otherwise noted use:
 - .1 Silicone Sealant for all exterior applications.
 - .2 Latex Sealant for all interior applications.

2.4 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 APPLICATION

- .1 Sealant.
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exist to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Use sufficient pressure to fill voids and joints solid.
 - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

- .3 Cleanup.
 - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses.
 - .3 Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A366/A366M-97e1, Standard Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled.
 - .2 ASTM A653/A 653M-15, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19MA, Rigid Vinyl Extrusions for Windows and Doors
- .3 Canadian Standards Association (CSA)
 - .1 CSA W59-13 - Welded steel construction (metal arc welding)
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .2 CSDMA, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames, 2012
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80: Standard for Fire Doors and Other Opening Protectives
- .6 RCMP
 - .1 RCMP Physical Security Guide G13-01, Secure Storage Room, July 2013 - Appendix A.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN4-S104-10, Standard Method for Fire Tests of Door Assemblies.

1.2 SUBMITTALS

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware and finishes.
 - .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing and finishes.
 - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 PERFORMANCE

- .1 Doors and Frames for Doors 008, 009 and 012 shall comply with RCMP Physical Security Guide G13-01, Secure Storage Room, July 2013.
- .2 Fire-rated doors and frames shall be labeled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104.

Part 2 Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A 653M, CS, Type B Coating Designation ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts unless otherwise noted.

2.2 ADHESIVES

- .1 Honeycomb cores: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.3 PRIMER

- .1 Touch-up primer to CAN/CGSB-1.181.

2.4 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Metallic paste filler: to manufacturer's standard.
- .3 Fire labels: metal riveted.
- .4 Exterior and interior top and bottom caps: steel.
- .5 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .6 Glazing: as per Section 08 80 50 - Glazing.
- .7 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
 - .2 Design exterior glazing stops to be tamperproof.

2.5 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass as indicated.
- .2 Exterior and interior doors: honeycomb construction.
- .3 Fabricate doors with longitudinal edges continuously welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .4 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .6 Reinforce doors where required, for surface mounted hardware.
- .7 Provide spot welded flush closing channels to top and bottom of doors.
- .8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.6 DOOR TYPE A – STANDARD

- .1 Door: minimum 1.27 mm cold rolled steel, commercial quality to ASTM A366.
- .2 Fire resistance rating: as noted in Door and Frame Schedule.
- .3 Acoustic (STC) Rating: 40.
- .4 Core: hexagonal cell kraft paper core.

2.7 DOOR TYPE B – SECURE DOOR

- .1 Door: minimum 1.59 mm cold rolled steel, commercial quality to ASTM A366.
- .2 Fire resistance rating: as noted in Door and Frame Schedule.
- .3 Acoustic (STC) Rating: 53.
- .4 Stiffeners:
 - .1 Hollow steel, vertically stiffened with minimum 0.91 mm galvanized steel interlocking “Z” or “top hat” shaped stiffeners welded at 150 mm on center.
 - .2 Weld front skin stiffeners offset to allow for 3 mm clearance of bottom stiffeners.

- .3 Form bottom stiffener to fill full thickness of door and with depth of 41 mm.
- .4 Offset stiffener in door core a minimum of 75 mm.

- .5 Insulation: Loose batt type, density 24 kg/m³ minimum, conforming to ASTM C553 or ASTM C592.

2.8 DOOR TYPE C – EXTERIOR

- .1 Door: minimum 1.27 mm cold rolled steel, commercial quality to ASTM A366.
- .2 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
- .3 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

2.9 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Frames: minimum 1.59 mm cold rolled steel, commercial quality to ASTM A366.
- .4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .5 Prepare frame for door silencers, 3 for single door.
- .6 Manufacturer's nameplates on frames and screens are not permitted.
- .7 Conceal fastenings except where exposed fastenings are indicated.
- .8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .9 Insulate exterior frame components with polyurethane insulation.

2.10 FRAME ANCHORAGE

- .1 Provide appropriate 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 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.11 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.

- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .4 Securely attach floor anchors to inside of each jamb profile.
- .5 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.12 FRAME TYPE A – STANDARD DOOR

- .1 Fire resistance rating: as noted in Door and Frame Schedule.
- .2 Acoustic (STC) Rating: 40.

2.13 FRAME TYPE B – SECURE DOOR

- .1 Fabricate in accordance with RCMP Physical Security Guide G13-01, Secure Storage Room, July 2013.
- .2 Fire resistance rating: as noted in Door and Frame Schedule.
- .3 Acoustic (STC) Rating: 40.
- .4 Reinforcement: weld 6.4 mm X 25 mm X 610 mm steel plate inside the frame and centered on the lock strike in accordance with RCMP G13-01.

2.12 FRAME TYPE C - EXTERIOR

- .1 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
- .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install Secure Doors and Frames in accordance with National Defence Security Orders and Directives, Version 3.0, Physical Security Technical Standards.

- .3 Install doors and frames to CSDMA, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

3.3 FRAME INSTALLATION

- .1 Fill voids between door frames and partition assemblies with mineral wool insulation.
- .2 Set frames plumb, square, level and at correct elevation.
- .3 Secure anchorages and connections to adjacent construction.
- .4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.
- .5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .6 Weld Frame Type B to metal framing stud of partition in accordance with RCMP Physical Security Guide G13-01, Secure Storage Room, July 2013.
- .7 Fully field weld head to jambs of knock-down frames and slip-on frames. Grind weld smooth. Apply touch up primer.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 DOOR AND FRAME SCHEDULE

- .1 Refer to Section 08 71 50 - Door and Frame Schedule.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
 - .2 ASTM E903-20, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
 - .3 ASTM F588-14, Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact
- .4 Canadian Standards Association (CSA)
 - .1 .CSA A440S1:19, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard/Specification for windows, doors, and skylights

1.2 SUBMITTALS

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Product data: Product literature and data sheets for each type of window, including product characteristics, performance criteria, physical sizes, finishes, example warranty documentation, and limitations.
- .3 Shop drawings:
 - .1 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim elevations of unit, anchorage details, description of related components and fasteners, and sealants. Indicate location of manufacturer's nameplates.
 - .2 Indicate locations, dimensions, openings, and requirements of related work.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 SITE CONDITIONS

- .1 Site measurements: Measure opening dimensions at the work site before fabrication. Indicate measurements on shop drawings.
- .2 Fire-rated doors and frames shall be labeled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104.

Part 2 Products

2.1 WINDOWS

- .1 Manufacturers:
 - 1. Product options: Provide windows from a single manufacturer.

2.2 REGULATORY REQUIREMENTS:

- .1 Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and CSA A440S1.
 - .1 Classification rating: to AAMA/WDMA/CSA 101/I.S.2/ A440.2/.3
 - .2 Primary designators: Classes: R

2.3 MATERIALS

- .1 General: In accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- .2 Window frames: Aluminum, thermally broken.
- .3 Glass: In accordance with Section 08 80 00 - Glazing.
- .4 Frame finishes: Anodized
- .5 .1 Colour: Match existing window colours.
- .6 Interior and exterior sills: Metal sills of type and size to suit job conditions; minimum 3 mm thick, complete with joint covers, jamb drip deflectors, chairs, and anchoring devices.
- .7 Isolation coatings: Manufacturer's standard alkali-resistant coatings.
- .8 Sealants: To AAMA 800, and compatible with sealants used in manufacture of insulating glass units and other material with which sealants come in contact.
 - .1 Sealants used to seal mechanically fixed joints: To AAMA 800 or ASTM C920, Type S, Grade S, Class 25.

2.4 FABRICATION

- .1 Fabrication windows in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, and:
 - .1 Fabricate units square and true, within tolerances in accordance with CSA A440.4.
 - .2 Brace frames to maintain squareness and rigidity during shipment and installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Visually inspect substrate: Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .2 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify rough openings are constructed within tolerances and with sufficient clearances in accordance with CSA A440.4.

3.2 INSTALLATION

- .1 Install windows in accordance with CSA A440.4 and manufacturer's instructions.
 - .1 Arrange components to prevent variation in colour.

3.3 Install solar control film in accordance with manufacturer's instructions.

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, and:
 - .1 Mark glass which may be subject to accidental breakage.

END OF SECTION

Construct New Workshop

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 28 13 00 – Access Control
- .2 Section 28 16 00 – Intrusion Detection System

1.2 REFERENCES

- .1 National Building Code of Canada – Latest Edition.
- .2 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2013, Butts and Hinges.
 - .2 ANSI/BHMA A156.3-2014, Exit Devices.
 - .3 ANSI/BHMA A156.4-2013, Door Controls - Closers.
 - .4 ANSI/BHMA A156.6-2010, Architectural Door Trim.
 - .5 ANSI/BHMA A156.8-2010, Door Controls – Overhead Stops & Holders.
 - .6 ANSI/BHMA A156.10, Power Operated Pedestrian Doors.
 - .7 ANSI/BHMA A156.13-2012, Mortise Locks.
 - .8 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .9 ANSI/BHMA A156.18-2012, Materials and Finishes.
 - .10 ANSI/BHMA A156.22-2012, Door Gasketing and Edge Seal Systems
 - .11 ANSI/BHMA A156.23-2010, Electromagnetic Locks
 - .12 ANSI/BHMA A156.31-2013, Electric Strikes and Frame Mounted Actuators
 - .13 ANSI/BHMA A156.36-2010 Auxiliary Locks
- .2 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions.

Construct New Workshop

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 door hardware for incorporation into manual.

1.4 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Tools: Supply 2 sets of wrenches for door closers and locksets.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Coordinate and integrate the selection of each hardware item with all other hardware and with doors and door frames to ensure no conflicts and full functionality.

1.6 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, labeled 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 indoors 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 or strippable coating.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARDWARE ITEMS

- .1 Use only one manufacturer's products for similar items.

Construct New Workshop

2.2 FINISHES

- .1 Aluminum as base material:
 - .1 Satin aluminum, clear anodized finish, to ANSI/BHMA A156.18 #628, unless otherwise noted.
 - .2 Mill finish aluminum only when satin aluminum, clear anodized finish is not a manufacturer's option.
- .2 Brass or bronze as base material:
 - .1 Satin chromium plated finish, to ANSI/BHMA A156.18 #626.
- .3 Steel as base material:
 - .1 Satin chromium plated finish, to ANSI/BHMA A156.18 #652.
- .4 Stainless steel as base material:
 - .1 Satin stainless steel finish to ANSI/BHMA A156.18 #630.
- .5 Zinc as base material:
 - .1 Satin chromium plated finish to ANSI/BHMA A156.18 #682.

2.3 DOOR HARDWARE

- .1 Astragal: Z-shaped, stainless steel, minimum 1.98 mm thickness, fastened on the stile side of the door.
- .2 Butt Hinges: to ANSI/BHMA A156.1, A1111, stainless steel, full mortise, five knuckle, four ball bearings, grade 1, heavy weight, non-removable pin (where noted), concealed electric (where noted), 114 mm X 114 mm X 3.4 mm. Acceptable Manufacturers: Dorex, Taymor, Hager, Stanley.
- .3 Closer: to ANSI A156.4, Grade 1, heavy-duty, double lever arm, surface mounted on door, push side mounted; maximum closing force 22 N, with stop function, aluminum cover. Acceptable Manufacturers: LCN, Sargent, Norton.
- .4 Cylinders for all locksets: Acceptable Manufacturers: Abloy, Medeco, Schlage Everest Primus.
 - .1 Cylinders must be compatible with one of the following inserts: CY5475, CY5476, CY5477, or CY5488.
- .5 Deadbolt: to ANSI/BHMA A156.36, Grade 1, keyed outside, thumbturn inside. Acceptable manufacturers: Schlage, Corbin Russwin, Sargent.
- .6 Door Sweep: extruded aluminum retainer with 45 mm nylon brush sweep, surface mounted.
- .7 Door Gaskets: extruded aluminum retainer with 6 mm diameter silicone gasket, surface mounted.
- .8 Door Supervisory Sensor provided by DCC Representative.

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- .9 Electric Exit Device: to ANSI/BHMA A156.3, Grade 1; mortise lock exit device, electric latch retraction, fail secure. Acceptable manufacturers: Hager, Sargent, Von Duprin.
- .10 Floor Stop: to ANSI 156.16, wrought brass or bronze, floor mounted, dome type, cushioned back, stud to prevent rotation, mechanically fastened to floor slab.
- .11 Flush Bolt: to ANSI/BHMA A156.3, Type 25, stainless steel and brass with steel components, automatically retracts when active door is opened / automatically extends when active door is closed, 19 mm throw, c/w dust proof strikes.
- .12 Latch Protector: 75 mm X 275 mm X 2.8 mm thickness, stainless steel.
- .13 Lockset:
 - .1 Mortise locks: to ANSI/BHMA A156.13, Series 1000, Grade 1.
 - .2 Function F01: passage set. Latchbolt retracted by knob/lever from either side at all times. Inside lever is always free for immediate egress.
 - .3 Function F02: privacy set. Outside knob/lever locked by pushbutton on inside knob/lever. Rotating inside knob/lever or closing door releases/unlocks button. Emergency release in outside knob/lever.
 - .4 Function F04: office and inner entry lock. Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.
 - .5 Function F07: storeroom lock. Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever is always inoperative. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.
 - .6 Lever handles: plain design, round bar, C-shape, 120 mm long.
 - .7 Strikes: stainless steel, box type, lip projection not beyond jamb.
 - .8 Rose: 65 mm diameter, wrought rose
 - .9 Throw: minimum 25 mm.
 - .10 Acceptable Manufacturers: Schlage, Corbin Russwin, Sargent.
- .14 Overhead Stop: to ANSI/BMHA 156.8, Grade 1, standard duty, overhead surface mounted, friction type, stops and hold door open, adjustable.
- .15 Power Door Operator and Door Operator Button: surface mounted on push side, non-handed, heavy-duty, with electrified lock monitoring and interior and exterior actuating controls to ANSI A156.10 and ANSI A156.19.
- .16 Pull Handle: straight J401, 200 mm long, 19 mm diameter, aluminum to ANSI A156.6
- .17 Threshold: extruded aluminum, minimum 6 mm high, maximum 13 mm high, with black rigid polypropylene thermal break, depth and length to suit door frame.
- .18 Exit Device: to ANSI/BHMA A156.3, Grade 1; mortise lock exit device, conventional push bar type, functions as noted.
 - .1 Lever trim to match mortise lock lever trim.
- .19 Electric Strike: heavy duty Grade 1 electric strike, stainless steel construction, UL/ULC listed for both burglar resistance and fire rated openings. Furnish with faceplate option to accommodate specified model and function of lockset, switchable for 12/24VDC.

Construct New Workshop

2.4 DEVICES RELATED TO DOORS

- .1 Card Reader: supplied and installed by Section 28 13 00 – Access Control.
- .2 Door Operator Buttons: supplied by Section 08 71 00; installed by Section 28 13 00 – Access Control.
- .3 Request to Exit Sensor: supplied and installed by Section 28 13 00 – Access Control.
- .4 Keypad: supplied and installed by Section 28 16 00 – Intrusion Detection System.

2.5 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Use fasteners compatible with material through which they pass.

2.6 KEYING

- .1 Doors to be keyed differently and master keyed as directed. Prepare detailed keying schedule in conjunction with DCC Representative.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to DCC Representative.

Part 3 Execution

3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.

Construct New Workshop

- .4 Install hardware to standard hardware location dimensions in accordance with CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.
- .5 Use only manufacturer's supplied fasteners. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .6 Remove construction cores when directed by DCC Representative. Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls 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 ensure tight fit at contact points with frames.
- .4 Adjust door to operate with opening force of less than 22 N.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

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

END OF SECTION

Door	From Room	To Room	Hand	Fire Resistance Rating (h)	Width (mm)	Height (mm)	Door Elevation	Glazing	Door Material & Type	Frame Material & Type	Hardware Group
D001	EXT	100	LHR/RHR	n/a	915	2134	DE2	n/a	IHM-C	TBPS-C	HG01
D002	EXT	101	LHR	n/a	EXISTING	EXISTING	EXISTING	n/a	EXISTING	TBPS-C	HG02
D003	EXT	110	RHR	n/a	915	2134	DE2	n/a	IHM-C	TBPS-C	HG03
D004	EXT	111	LHR	n/a	915	2134	DE2	n/a	IHM-C	TBPS-C	HG03
D005	100	101	LHR/RHR	n/a	915	2134	DE1	n/a	IHM	PS-A	HG04
D006	100	101	RH	n/a	915	2134	DE1	n/a	IHM	PS-A	HG05
D007	101	102	RH	n/a	915	2134	DE1	n/a	IHM	PS-A	HG06
D008	101	104	LH	n/a	915	2134	DE1	n/a	IHM-B	PS-B	HG07
D009	105	106	LHR	n/a	915	2134	DE1	n/a	IHM-B	PS-B	HG08
D010	100	107	RHR	n/a	915	2134	DE1	n/a	IHM	PS-A	HG07
D011	107	108	RH	n/a	762	2134	DE1	n/a	IHM	PS-A	HG09
D012	107	109	RH	n/a	915	2134	DE1	n/a	IHM	PS-A	HG07
D013	107	108	LH	n/a	762	2134	DE1	n/a	IHM	PS-A	HG09
D014	EXT	100	LHR	n/a	EXISTING	EXISTING	EXISTING	n/a	EXISTING	EXISTING	HG10

ABBREVIATIONS:

EXT	EXTERIOR
FG-T	FLAT GLASS – TEMPERED (SEE SECTION 08 80 50 – GLAZING)
HM-X	HOLLOW METAL – TYPE (SEE SECTION 08 11 00 – METAL DOORS AND FRAMES)
IGU	INSULATED GLASS UNIT (SEE SECTION 08 80 50 – GLAZING)
IHM-X	INSULATED HOLLOW METAL – TYPE (SEE SECTION 08 11 00 – METAL DOORS AND FRAMES)
PS-X	PRESSED STEEL – TYPE (SEE SECTION 08 11 00 – METAL DOORS AND FRAMES)
TBPS-X	THERMALLY BROKEN PRESSED STEEL – TYPE (SEE SECTION 08 11 00 – METAL DOORS AND FRAMES)

NOTES:

- 1 ALL PRESSED STEEL FRAMES AND HOLLOW METAL DOORS ARE TO BE PAINTED.
- 2 ALL DOORS ARE 45 mm THICK.

END OF SECTION

Provide the following door hardware. Refer to Section 08 71 50 - Door & Frame Schedule for the Hardware Group required for each door opening.

1. Hardware Group HG01: Door D001

- 1.1. Power Door Operator: two
- 1.2. Butt Hinges: 3 pair hinges, non-removable pins
- 1.3. Exit Device: one
- 1.4. Electric Strike: one
- 1.5. Door Sweep: two
- 1.6. Door Gaskets: one set
- 1.7. Threshold: one
- 1.8. Door contact (By Others): two
- 1.9. Request to exit (By Others): one
- 1.10. Card Reader - outside (By Others): one

2. Hardware Group HG02: Door D002

- 2.1. Power Door Operator: one
- 2.2. Lockset: one, Function F07 (store room lock)
- 2.3. Butt Hinges: 1-1/2 pair hinges, non-removable pins, one concealed electric type
- 2.4. Electric Strike: one
- 2.5. Door Sweep: one
- 2.6. Door Gaskets: one set
- 2.7. Threshold: one
- 2.8. Door contact (By Others): one
- 2.9. Request to exit (By Others): one
- 2.10. Card Reader - outside (By Others): one

3. Hardware Group HG03: (Doors D003, D004)

- 3.1. Butt Hinges: 1-1/2 pair hinges
- 3.2. Lockset: one, Function F07 (store room lock)
- 3.3. Closer: one
- 3.4. Threshold: one
- 3.5. Door Sweep: one

4. Hardware Group HG04: (Door D005)

- 4.1. Butt Hinges: 3 pair hinges
- 4.2. Lockset: one, Function F07 (store room lock)
- 4.3. Electric Strike: one
- 4.4. Closer: two
- 4.5. Lockset: Function F07 (store room lock)
- 4.6. Flushbolt : one
- 4.7. Wall stop: one

5. Hardware Group HG05: (Door D006)

- 5.1. Butt Hinges: 1-1/2 pair hinges
- 5.2. Closer: one
- 5.3. Electric Strike: one
- 5.4. Lockset: one, Function F07 (store room lock)
- 5.5. Floor Stop: one
- 5.6. Door contact (By Others): one
- 5.7. Request to exit (By Others): one
- 5.8. Card Reader - outside (By Others): one

-
- 6. Hardware Group HG06: (Door D007)**
- 6.1. Butt Hinges: 1-1/2 pair hinges
 - 6.2. Lockset: one, Function F04 (office lock)
 - 6.3. Floor Stop: one
- 7. Hardware Group HG07: (Doors D008, D010, D012)**
- 7.1. Butt Hinges: 1-1/2 pair hinges
 - 7.2. Lockset: one, Function F07 (store room lock)
 - 7.3. Closer: one
 - 7.4. Floor Stop: one
 - 7.5. Door Sweep: one
 - 7.6. Door Gaskets: one set
 - 7.7. Threshold: one
 - 7.8. Door contact (By Others): two
 - 7.9. Request to exit (By Others): one
 - 7.10. Card Reader - outside (By Others): one
 - 7.11. Card Reader - inside (By Others): one
- 8. Hardware Group HG08: (Door D009)**
- 8.1. Butt Hinges: 1-1/2 pair hinges
 - 8.2. Lockset: one, Function F07 (store room lock)
 - 8.3. Closer: one
 - 8.4. Floor Stop: one
 - 8.5. Door Sweep: one
 - 8.6. Door Gaskets: one set
 - 8.7. Threshold: one
 - 8.8. Door contact (By Others): one
 - 8.9. Card Reader - inside (By Others): one
- 9. Hardware Group HG09: (Door D011 and D013)**
- 9.1. Butt Hinges: 1-1/2 pair hinges
 - 9.2. Lockset: one, Function F07 (store room lock)
 - 9.3. Closer: one
 - 9.4. Floor Stop: one
 - 9.5. Door contact (By Others): one
 - 9.6. Card Reader - inside (By Others): one
- 10. Hardware Group HG10: (Doors D014)**
- 10.1. Butt Hinges: Existing
 - 10.2. Lockset: Existing
 - 10.3. Closer: Existing
 - 10.4. Door Sweep: Existing
 - 10.5. Door Gaskets: Existing
 - 10.6. Threshold: Existing
 - 10.7. Electric Strike: one
 - 10.8. Door contact (By Others): two
 - 10.9. Request to exit (By Others): one
 - 10.10. Card Reader - outside (By Others): one
 - 10.11. Card Reader - inside (By Others): one

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C542-05(2015), Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D2240-15, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
 - .3 CAN/CGSB-12.8-97, Insulating Glass Units.
- .3 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual 50th Anniversary Edition-2008.
 - .2 GANA Sealant Manual-2008.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 MATERIALS

- .1 Flat Glass (FG-T):
 - .1 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm thick.
 - .1 Type 2-tempered.
 - .2 Class B-float.
- .2 Insulating Glass Units (IGU):
 - .1 Insulating glass units: to CAN/CGSB-12.8, double unit, 25 mm overall thickness.
 - .1 Outer Glass: clear tempered to CAN/CGSB-12.1.
 - .2 Inner Glass: clear float to CAN/CGSB-12.3.
 - .3 Glass thickness: 6 mm each light
 - .4 Inter-cavity space thickness: 13 mm between inner and middle lights with low conductivity spacers.
 - .5 Inert gas fill: argon.
- .3 Sealant: in accordance with Section 07 92 00.

2.2 ACCESSORIES

- .1 Setting blocks: EPDM 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .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: 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 splines: resilient polyvinyl chloride silicone, extruded shape to suit glazing channel retaining slot, black colour.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written 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 substrate in presence of DCC Representative.
 - .4 Inform DCC Representative 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 DCC Representative.

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.

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 for glazing installation methods.
- .3 Cut glazing tape or spline to length; install on glazing light. Seal corners by butting tape or spline and sealing junctions with sealant in accordance with GANA Sealant Manual.
- .4 Place setting blocks at 1/4 or 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 or spline. 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 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 1/4 or 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 light 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.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.12 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
- .3 Repair damage to adjacent materials caused by glazing installation.

3.13 SCHEDULE

- .1 Flat Glass – Tempered (FG-T): all lites in interior doors.
- .2 Insulating Glass Units (IGU): all lites in exterior doors and overhead doors.

END OF SECTION

Construct New Workshop

PART 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A1008/A1008M-15, 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 A1011/A1011M-14, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - .3 ASTM A366/A366M-97e1, Standard Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled.
 - .4 ASTM C1396/C1396M-14a, Standard Specification for Gypsum Wallboard.
 - .5 ASTM C36/C36M-03e1, Standard Specification for Gypsum Wallboard.
 - .6 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .7 ASTM C645-14, Standard Specification for Nonstructural Steel Framing Members.
 - .8 ASTM C754-15, Standard Specification for Installation of Steel Framing Members to receive Screw-Attached Gypsum Panel Products.
 - .9 ASTM C 840-13, Standard Specification for Application and Finishing of Gypsum Board.
 - .10 ASTM C 954-15, 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 0.122 in. (2.84 mm) in Thickness.
 - .11 ASTM C 1002-14, 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.
 - .12 ASTM C 1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .13 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne sound Transmission Loss of Building Partitions and Elements
 - .14 ASTM E136-12, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
- .2 National Association of Architectural Metal Manufacturers.
 - .1 EMMA 557-99 - Standards for Expanded Metal.
- .3 Royal Canadian Mounted Police (RCMP)
 - .1 RCMP G13-01, Secure Storage Room, Physical Security Guide, July 2013.
- .4 Department of National Defence and Canadian Armed Forces
 - .1 National Defence Security Orders and Directives, Physical Security Technical Standards, Standard M: Security of Arms, Ammunition and Explosives, Ver. 2.0.

1.2 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 protection material, gypsum, framing, sealants, mechanical fasteners and include product characteristics, performance criteria, physical size, finish and limitations.

Construct New Workshop

1.3 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.

PART 2 Products

2.1 PERFORMANCE

- .1 Secure partitions to comply with RCMP G13-01 - Appendix A.
- .2 Unless otherwise indicated on drawings, minimum sound transmission class rating of installed partitions to be STC 30 as tested to ASTM E90.

2.2 MATERIALS

- .1 Metal Framing:
 - .1 Studs: to ASTM C 645, 40 mm flange, 152 mm web, 16 mm return, roll formed from 1.27 mm thickness hot dipped galvanized steel sheet. Knock-out service holes at 460 mm centres.
 - .2 Floor and ceiling tracks: to ASTM C 645, 40 mm flange, 152 mm web, roll formed from 1.27 mm thickness hot dipped galvanized steel sheet.
- .2 Board Products:
 - .1 Interior gypsum board: to ASTM C 36/C36M regular, 15.9 mm thick, Type X, 1200 mm wide x maximum practical length, ends square cut, edges beveled.
 - .2 Interior gypsum board: to ASTM C 36/C36M regular, 12.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges beveled.
 - .3 Glass mat water-resistatant gypsum backing board: to ASTM C 1178/C1178M regular, 15.9 mm thick, Type X, 1200 mm wide x maximum practical length, ends square cut, edges beveled.
- .3 Protection Material:
 - .1 Option 1 - Flattened Metal Mesh: to EMMA 557-99, style ¾"-#9 F, 3.2 mm nominal thickness, 17 mm X 39 mm diamond opening, nominal strand thickness 3 mm, standard-carbon steel.
 - .2 Option 2 – Sheet Steel: to ASTM A1008/A1008M-15 or ASTM A1011/A1011M-14, 1.6 mm thickness.
- .4 Wall Reinforcement:
 - .1 Sheet Steel: to ASTM A366, HR Commercial Quality, 1.6 mm thickness.
- .5 Mechanical Fasteners:
 - .1 Rivets: 4.8 mm pop rivets, steel body and mandrel.
 - .2 Washer: 32 mm OD X 4.8 mm ID low carbon zinc finish steel fender washer.
 - .3 Drywall Screws: to ASTM C954 or ASTM C1002.
 - .4 Double Expansion Anchors: steel, minimum 6 mm bolt diameter; minimum 33 mm anchor length.
 - .5 Concrete Screws: minimum 4.8 mm diameter; minimum 45 mm length, hex slotted head, steel fluorocarbon coated.
 - .6 Metal Framing Screws: drill or sharp point steel screws
 - .7 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

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- .6 Acoustical foam seal: moisture resistant, 3 mm thick closed cell neoprene strip, width to match width of framing tracks or studs, self-sticking permanent adhesive on one face, lengths as required.
- .7 Joint compound: to ASTM C475, asbestos-free.
- .8 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .9 Acoustic Sealants in accordance with Section 07 92 00 - Joint Sealants.
- .10 Joint tape: 50mm wide, 10x10 glass mesh tape.
- .11 Insulating strip: rubberized, moisture resistant, 3 mm thick cork closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

PART 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install secure partitions in accordance with RCMP G13-01 – Secure Storage Room, around Rooms 36 and 37.

3.2 VERIFICATION

- .1 Verify conditions of substrates previously installed under other Sections are acceptable for product installation in accordance with manufacturer's written instructions prior to partition installation.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.3 ERECTION OF METAL FRAMING

- .1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
- .2 Install acoustical foam seal under floor tracks, above ceiling tracks and between studs and flanking walls around perimeter of partitions.
- .3 Align partition tracks from floor to floor and secure at 300 mm on centre maximum with double expansion anchors.
- .4 Secure partitions: place studs vertically at 300 mm on centre and maximum of 50 mm from abutting walls, and at each side of openings and corners. Provide double stud at doors. Position studs in tracks at floor and ceiling. Secure stud to tracks with welds or rivets. Install anti-spread bracing between double studs of door opening and next stud and position 1200 mm above the floor. Install additional horizontal and vertical framing measure to support all edges of protection material.

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- .5 Erect studding to tolerance of 1:1000.
- .6 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Erect track at head of door/window openings, duct openings and window sills to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .8 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .9 Install studs or furring channel between studs for attaching electrical and other boxes.
- .10 Extend partitions to underside of structure.
- .11 Maintain clearance under beams and roof framing to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks or double track slip joint.
- .12 For partitions having an STC rating of 35 or more, install two continuous beads of acoustical sealant under studs and tracks.

3.4 SOUND ATTENUATION INSULATION

- .1 Install sound attenuation insulation in partitions as indicated.
- .2 Install insulation by friction fit to maintain continuity of acoustic isolation between spaces. Extend insulation into bulkheads associated with partition.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .4 Do not compress insulation to fit into spaces.
- .5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.
- .6 Do not enclose insulation until it has been inspected and approved by DCC Representative.

3.5 INSTALLATION OF PROTECTION MATERIAL

- .1 Install Protection Material on secure partitions and on exterior walls.
- .2 Position protection material so that all edges are supported by metal framing.
- .3 Protection Material Option 1 – Flattened Metal Mesh:
 - .1 Fastening options:
 - .1 Secure mesh to metal framing with 3 mm fillet welds at 200 mm on centre.
 - .2 Secure mesh to metal framing with rivets and washers at 200 mm on center.
- .4 Protection Material Option 2 – Sheet Steel:
 - .1 Fastening options:
 - .1 Secure sheets to metal framing with 1.5 mm fillet welds, 15 mm long, or 8 mm plug weld at 200 mm on centre.
 - .2 Secure sheets to metal framing with rivets at 200 mm on centre.

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3.6 INSTALLATION OF WALL REINFORCEMENT

- .1 Notwithstanding the use of Protection Material, install Wall Reinforcement consisting of sheet steel at doors in secure partitions.
- .2 Wall Reinforcement is to extend 1200 mm horizontally and vertically past the jambs and heads of the doors.
- .3 Locate Wall Reinforcement on opposite side of metal framing than Protection Material.
- .4 Fastening options:
 - .1 Secure sheets to metal framing with 1.5 mm fillet welds, 15 mm long, or 8 mm plug weld at 200 mm on centre.
 - .2 Secure sheets to metal framing with rivets at 200 mm on centre.

3.7 ERECTION OF GYPSUM BOARD AND ACCESSORIES

- .1 Do application and finishing of gypsum board in accordance with ASTM C 840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings, in accordance with ASTM C840 except where specified otherwise.
- .3 Install acoustical insulation in sound rated partitions to fill all voids in cavities of framing system.
- .4 Install acoustic sealant in sound rated partitions:
 - .1 at perimeter junction of outer layer of gypsum and floor slab, ceiling slab and flanking walls.
 - .2 at all penetrations through the gypsum board on both the inside and outside face.
 - .3 at perimeter of all junction and outlet boxes.
- .5 Install gypsum boards in direction that will minimize number of end-butt joints. Stagger end joints 250 mm minimum.

3.8 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to metal framing using drywall screws. Maximum spacing of screws 300 mm on centre.
- .3 Apply water-resistant gypsum board where wall tiles or coating to be applied and adjacent to slop sinks, janitors closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

3.9 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 where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

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- .3 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .4 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .5 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .6 Complete installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.10 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.11 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C635/C635M-13a, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .2 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .3 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
 - .4 ASTM E1477-98a(2013), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATION SUBMITTALS

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

1.3 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.

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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

Part 2 Products

2.1 MATERIALS

- .1 Type 1: Acoustic units for suspended ceiling system type C3: to ASTM E1264, Type III, Form 2, Pattern CD.
 - .1 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
 - .2 Smoke developed 50 or less in accordance with CAN/ULC-S102.
 - .3 Noise Reduction Coefficient (NRC) designation of 0.55.
 - .4 Ceiling Attenuation Class (CAC) rating 35, in accordance with ASTM E1264.
 - .5 Light Reflectance (LR) range of 0.81 to ASTM E 1477.

- .6 Edge type square.
- .7 Colour white.
- .8 Size 610 mm x 1220 mm x 16 mm thick.
- .9 Shape flat.

.2 Performance/Design Criteria:

- .1 Maximum deflection: 1/360th of span to ASTM C635/C635M deflection test.

ACCESSORIES

Touch-up paint: in accordance with manufacturer's recommendations for surface conditions: Fit and shop assemble work, ready for erection.

Execution

EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to acoustical ceiling installation.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

2.2 INSTALLATION

- .1 Installation: in accordance with ASTM C636/C636M except where specified otherwise.
- .2 Suspension System:
 - .1 Erect ceiling suspension system after work above ceiling has been inspected by DCC Representative.
 - .2 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
 - .3 Lay out centreline of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width system according to reflected ceiling plan.
 - .4 Install wall moulding to provide correct ceiling height.

- .6 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers grilles and speakers.
- .7 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .8 Interlock cross member to main runner to provide rigid assembly.
- .9 Ensure finished ceiling system is square with adjoining walls and level within 1:1000.
- .3 Acoustic Panels:
 - .1 Install acoustical panels and tiles in ceiling suspension system.
 - .2 Co-ordinate ceiling work with work of other sections such as interior lighting, fire protection, communication, and intrusion and detection systems.
- .4 Interface with Other Work
 - .1 Co-ordinate 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 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM F1066-04 (2018), Standard Specification for Vinyl Composition Floor Tile.

1.2 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for resilient sheet flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples: Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, nosing, feature strips, treads, edge strips.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials, off ground, indoors, in dry location 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.

1.4 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Maintain air temperature and structural base temperature at flooring installation area above 20 degrees for 48 hours before, during and 48 hours after installation.

Part 2 Products

2.1 MATERIALS

- .1 Vinyl composition tile: to ASTM F 1066, Composition 1 - non asbestos Class 1 - solid colour, non-asbestos Class 1 - solid colour 2 mm x 305 x 305 mm size. Colour to be selected by Departmental Representative from manufacturer's standard colour range.
- .2 Static Dissipative Resilient Tile Flooring (Antistatic flooring): to ASTM F 150:
 - .1 Tile size: 305 x 305mm
 - .2 Wear layer/overall thickness: 3.17mm
 - .3 ASTM D3389, Abrasion Resistance (H-22 500 g @ 1,000 cycles)
 - .4 ASTM E 648, Standard test method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I
 - .5 ASTM E 662, Smoke Density equal to or less than 450.
 - .6 ASTM F 137 Flexibility, Pass.
 - .7 Meet ASTM F 150, Equal to or greater than 1 megohms (≥ 106 Ohms) & Equal to or less than 1,000 megohms (≤ 109 Ohms).
 - .8 ASTM F 925 Chemical Resistance, Meets requirement.
 - .9 ASTM F 970 Static Load (modified at 2,500 psi), equal to or less than 0.005"
 - .10 ASTM F 1700 Solid Vinyl Floor Tile, Class I, Type A

- .11 Static Propensity, Complies
- .12 Indoor Air Quality(IAQ), SCS FloorScore Certified
- .13 Volatile Organic Compounds (VOC's)Registration Number SCS-FS-01495,
- .14 Adhesive, AD-555SF, Regular traffic & heavy rolling traffic.
- .15 Ground strips:
 - .1 Copper grounding strip as recommended by flooring manufacturer for use with their product.
- .16 One tile per room at entry door to room to say "No Wax".
- .17 Colour: selected by DCC Representative.
- .3 Resilient base: coved toe:
 - .1 Type: vinyl
 - .2 Style: 100 mm high.
 - .3 Thickness: 3 mm.
 - .4 Lengths: cut lengths minimum 2400 mm.
 - .5 Colour: selected by DCC Representative.
- .4 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- .5 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste 2 part latex-type filler requiring no water as recommended by flooring manufacturer for use with their product.
- .6 External corner protectors: type recommended by flooring manufacturer.
- .7 Edging to floor penetrations: type recommended by flooring manufacturer.
- .8 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.

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 resilient sheet flooring installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 SITE VERIFICATION OF CONDITIONS

- .1 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.3 PREPARATION

- .1 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .3 Prime or Seal concrete slab to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

- .1 Provide a high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to the outside. Do not let contaminated air

recirculate through a district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.

- .2 To minimize emissions from adhesives, use water-based, solvent-free styrene-butadiene-rubber adhesive for linoleum. Butadiene exposure may cause eye and nose irritations, headaches, dizziness, and vomiting.
- .3 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 As installation progresses, and after installation, roll flooring in 2 directions with 45 kg minimum roller to ensure full adhesion.
- .5 Cut tile and fit neatly around fixed objects.
- .6 Install feature strips and floor markings where indicated. Fit joints tightly.
- .7 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .8 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4

APPLICATION: BASE

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000
- .6 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.
- .7 Cope internal corners. Use pre-moulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
- .8 Heat weld base in accordance with manufacturer's printed instructions.

3.5

CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
 - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.

3.6

TESTING FOR STATIC DISSIPATIVE FLOORING

- .1 Test flooring in accordance with ANSI/ESD DSTM7.1.
 - .1 Measure resistance to ground between electrode placed 915mm from wall and ground. Make five resistance to ground measurements at different locations within area.

.2 Acceptance criteria: average reading of minimum 1×10^6 Ohms, and maximum 1×10^9 Ohms.

.3 Perform testing prior to hand over date to Departmental Representative.

3.7

PROTECTION

- .1 Protect new floors after initial waxing until final waxing final inspection.
- .2 Prohibit traffic on floors after installation

Construct New Workshop

Part 1 General

1.1 RELATED DOCUMENTS

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- .1 This Section includes one resinous flooring system, one with epoxy body.
 - .1 Application Method: Metal, power or hand troweled.

1.3 SUBMITTALS

- .1 Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- .2 Samples for Verification: For each resinous flooring system required, 150 mm square, applied to a rigid backing by Installer for this Project.
- .3 Room Finish Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in room finish schedule.
- .4 Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- .5 Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- .1 No request for substitution shall be considered that would change the generic type of floor system specified (i.e. epoxy mortar based system). Equivalent materials of other manufactures may be substituted only on approval of Departmental Representative. Request for substitution will only be considered only if submitted 10 days prior to bid date. Request will be subject to specification requirements described in this section.
- .2 Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
 - .1 Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
 - .2 Contractor shall have completed at least 10 projects of similar size and complexity.
- .3 Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

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- .4 Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
 - .1 Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- .5 Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - .1 Apply full-thickness mockups on 10 m² floor area selected by Departmental Representative.
 - .1 Include minimum 1 m length of integral cove base.
 - .2 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- .6 Pre-installation Conference:
 - .1 General contractor shall arrange a meeting not less than thirty days prior to starting work.
 - .2 Attendance:
 - .1 General Contractor
 - .2 Departmental Representative
 - .3 Manufacturer/Installer's Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- .2 Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- .3 All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.6 PROJECT CONDITIONS

- .1 Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
 - .1 Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.
- .2 Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- .3 Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.
- .4 Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

Construct New Workshop

1.7 WARRANTY

- .1 Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation.

Part 2 Products

2.1 RESINOUS FLOORING

- .1 System Characteristics:
 - .1 Color and Pattern: selected by DCC Representative.
 - .2 Wearing Surface: Slip resistant
 - .3 Integral Cove Base: yes, continuous epoxy base
 - .4 Overall System Thickness: nominal 6 mm
- .2 System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - .1 Primer:
 - .1 Material Basis: Standard Primer
 - .2 Resin: Epoxy
 - .3 Formulation Description: (2) two component, 100 percent solids.
 - .4 Application Method: Squeegee and roller.
 - .5 Number of Coats: (1) one.
 - .2 Mortar Base:
 - .1 Resin: Epoxy.
Formulation Description: (3) three component, 100 percent solids.
 - .2 Application Method: Metal Trowel.
 - .1 Thickness of Coats: nominal 6mm.
 - .2 Number of Coats: One.
 - .3 Aggregates: Pigmented Blended aggregate.
 - .3 Top Coat:
 - .1 Resin: Epoxy.
 - .2 Formulation Description: (2) two component, 100 percent solids.
 - .3 Type: pigmented.
 - .4 Finish: standard.
 - .5 Number of Coats: one.
- .3 System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - .1 Compressive Strength: 10,000 psi after 7 days per ASTM C 579.
 - .2 Tensile Strength: 1,750 psi per ASTM C 307.
 - .3 Flexural Strength: 4,000 psi per ASTM C 580.
 - .4 Water Absorption: < 1% per ASTM C 413.
 - .5 Impact Resistance: > 160 in. lbs. per ASTM D 2794.
 - .6 Flammability: Class 1 per ASTM E-648.
 - .7 Hardness: 85 to 90, Shore D per ASTM D 2240.

Construct New Workshop

2.2 ACCESSORY MATERIALS

- .3 Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- .4 Joint Sealant: Type recommended or produced by resinous flooring manufacturer.

Part 3 Execution

3.1 PREPARATION

- .1 General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
- .2 Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - .1 Mechanically prepare substrates as follows:
 - .1 Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - .2 Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
 - .2 Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 - .3 Verify that concrete substrates are dry.
 - .1 Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 75 percent.
 - .2 Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. of slab in 24 hours.
 - .3 Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 - .4 Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- .3 Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- .4 Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- .5 Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

- .1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - .1 Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - .2 Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - .3 At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - .1 Apply joint sealant to comply with manufacturer's written recommendations.
- .2 Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- .3 Integral Cove Base: mortar, apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
 - .1 Integral Cove Base: 100 mm high.
- .4 Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- .5 Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 TERMINATIONS

- .1 Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
- .2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- .3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- .4 Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.4 JOINTS AND CRACKS

- .1 Treat control joints to bridge potential cracks and to maintain monolithic protection.
- .2 Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- .3 Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.5 FIELD QUALITY CONTROL

- .1 Material Sampling: Departmental Representative may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
 - .1 Departmental Representative will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - .2 Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - .3 If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.6 CLEANING, PROTECTING, AND CURING

- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.
- .2 Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- .3 Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION

Construct New Workshop

Part 1 General

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - 2018
 - .2 Maintenance Repainting Manual - 2018

1.2 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 paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 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 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
 - .1 Supply 9 kg Type ABC dry chemical 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 National Fire Code of Canada requirements.

1.4 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 – Temporary Utilities.
 - .2 Co-ordinate use of existing ventilation system with DCC Representative and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.

Construct New Workshop

- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional 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.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials: (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
- .4 Colours:
 - .1 DCC Representative will provide Colour Schedule.
 - .2 Base paint colour schedule on selection of 5 base colours and 3 accent colours.
 - .3 Base stain colour schedule on selection of 3 base colours.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from DCC Representative for tinting of painting materials.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
 - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
 - .4 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.

Construct New Workshop

- .6 Gloss/sheen ratings:
.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level Category	Gloss at 60 Degrees	Sheen at 85 Degrees
Gloss Level 1 - Matte	Maximum 5	Maximum 10
Gloss Level 2 - Velvet	Maximum 10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	Minimum 35
Gloss Level 5 – Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 – High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated and as noted on Finish Schedule.
- .7 Exterior painting:
.1 Galvanized Metal Doors and Frames: EXT 5.3A - Latex Gloss Level 5 finish.
.2 Structural Steel and Metal Fabrications (columns, beams, joists and miscellaneous metal): REX 5.1D - Alkyd insert gloss level.
.3 Galvanized Metal: high contact/high traffic areas (railings and handrails, etc.) - EXT 5.3B - Latex insert gloss level.
- .8 Interior painting:
.1 Galvanized Metal Doors and Frames: INT 5.3C - Latex Gloss Level 1 finish (over cementitious primer).
.2 Gypsum board: INT 9.2A - Latex Gloss Level 3 finish (over latex sealer)
.3 Wood Doors, Casings, Mouldings: INT 6.3E Polyurethane varnish Gloss Level 4 finish (over stain).
.4 Galvanized Metals - Sprinkler Pipes, Duct Work, Conduits: – 5.3A - Latex Gloss Level 5 finish. (over w.b. galvanized primer)

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 sheets.
- .2 Perform preparation and operations for painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

3.2 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted / stained. Report to DCC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 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.

Construct New Workshop

3.3 PREPARATION

- .1 Protection of in-place conditions:
 - .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 DCC Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
 - .5 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.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Countersink nailheads, clean soiled surfaces, sand smooth and dust off.
 - .3 Apply wood filler to nail holes, splits, cracks and scratches after prime coat has been applied and dried.
 - .4 Tint filler to match stains for stained woodwork.
 - .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.
 - .8 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.
 - .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by DCC Representative.
- .2 Use method of application appropriate for intended purposes. Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.

Construct New Workshop

- .6 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.
- .7 Finish closets and alcoves as specified for adjoining rooms.
- .8 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .9 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint fire protection piping red.
 - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
 - .6 Paint natural gas piping yellow.
 - .7 Paint both sides and edges of backboards for mechanical and electrical equipment before installation.
 - .8 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip. Withdrawn 2014, no replacement.
 - .3 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA International
 - .1 CSA B651-18, Accessible Design for the Built Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00. Deliver special tools to DDC Representative.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating, minimum 30% recycled content.
- .2 Stainless steel sheet metal: to ASTM A167, Type 304, with satin finish, minimum 75% recycled content.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness, minimum 75% recycled content.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

- .1 Toilet tissue dispenser: double roll type, surface mounted, chrome plated steel frame, capacity of 500 double ply roll, roll under spring tension for controlled delivery.
- .2 Paper towel dispenser: for folded and roll paper towels, stainless steel cabinet, hinged front panel, refill indicator slot, lock and key, surface mounted.
- .3 Soap dispenser: liquid push-in valve 64 mm spout, self-contained 340 mL translucent polyethylene 1.5 L tank , stainless steel piston and valve assembly, tamper proof filler lock, surface mounted, exposed metal components chrome plated.
- .4 Feminine napkin disposal bin: stainless steel , surface unit, continuous hinged door, self-closing, embossed with "napkin disposal" and "receptacle de serviette-sanitaire", removable stainless steel receptacles fitted with spring clip for deodorizer block.
- .5 Shower curtain: 0.178 mm thick translucent vinyl shower curtain. Provide curtain hold-back hook and chain at each curtain.
- .6 Shower rods: 38 mm diameter x 2 mm wall thickness stainless steel tubing of required length with satin chrome finished flanges, 12 shower curtain hooks and curtain hold-back hook and chain. Shower rod material and anchorage to withstand downward pull of 0.9 kN.
- .7 Shower seat: wall mounted folding , plastic laminate .
- .8 Towel holder: wall mounted, stainless steel rod, holding capacity of two bath towels.
- .9 Grab bars: 30 to 40 mm diameter x 1.6 mm wall tubing of stainless steel , 76 mm diameter wall flanges, exposed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Designed to maintain a gap of between 35 and 45 mm between bar and wall surface. Grab bar material and anchorage to withstand force of 1.3 kN applied in any direction. Minimum lengths:
 - .1 behind water closet: straight 600 mm
 - .2 beside water closet: L-shaped, 760 mm X 760 mm
 - .3 shower stall: straight, two X 1000 mm, 750 mm, 600 mm

- .10 Soap holder: surface mounted, 5 mm thick stainless steel dished tray, self-draining, flush screws.
- .11 Robe hook: stainless steel with 75 mm projection.
- .12 Mirror: wall mounted unit, 6 mm, stainless steel frame with integral shelf , 600 mm wide X 760 mm high.
- .13 Shelf recessed surface mounted, 200 deep, 400 wide, stainless steel.

2.3 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to ASTM A123/A123M.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from DCC Representative.

3.2 INSTALLATION

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.

- .2 Install grab bars on built-in anchors provided by bar manufacturer to NBC and CSA B651 .
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.

3.3 ADJUSTING

- .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11. 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 11.

3.5 PROTECTION

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

3.6 SCHEDULE

- 1 Locate accessories where indicated and as follows. Exact locations determined by DCC Representative.
- .2 Toilet tissue dispenser: one in each washroom, mounting height 700 mm above finished floor.
- .3 Paper towel dispenser: one in each washroom one per two wash basins. Maximum height of dispenser and operable part from floor 1100 mm.
- .4 Soap dispenser: one at each wash basin.
- .5 Feminine napkin disposal bin: one in each washroom mounting height 700 mm above finished floor.
- .6 Shower rod and curtain: one at each shower compartment mounting height 2000 mm above finished floor.
- .7 Shower seat: one at each shower, one at each bathtub, mounting height from floor 625 mm.
- .8 Towel holder: one at each shower, mounting height from floor 1100 mm.
- .9 Grab bar: as per CSA B651
- .10 Soap holder: one at each shower Maximum height from floor 1100 mm.

- .11 Robe hook: one in each shower stall mounting height 1200 mm above finished floor.
- .12 Mirror: one at each accessible wash basin, height of bottom edge of mirror from floor 1000 mm.
- .13 Shelf: one in each washroom, mounting height from floor 1000 mm.

END OF SECTION

Appendix A
Typical Security Standard Drawings

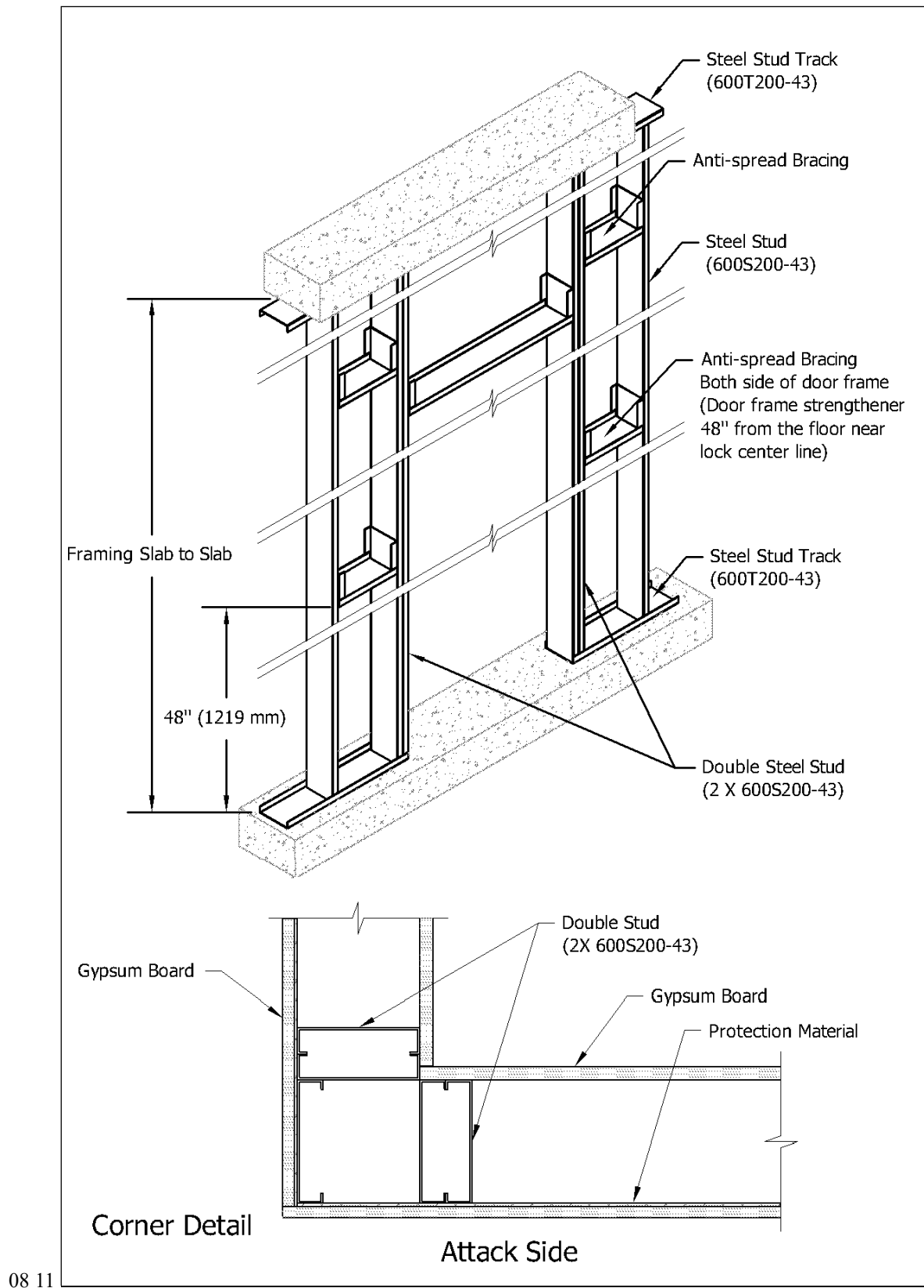


Figure 1: Wall Framing Detail

Wall Protection Material (Figures 2 to 4)

Wall protection material may be one of two options:

Flattened Metal Mesh: To EMMA 557-99. Style ¾-9F: nominal strand thickness of 0.120" (0.108" to 0.132"). Diamond opening of 0.563" x 1.688".

OR

Sheet Steel: 16 Ga, A1008 / A1008M (cold rolled) or A1011 / A1011M (hot rolled) or equivalent.

Mount on the outside (attack side) of the room. Support all edges by anti-spread bracing, studs or corners. Align the sheet edges at every vertical and horizontal seam on the centre line of the steel stud or anti-spread bracing and secure all sheets with welds or rivets.

Note: Screws (including "security screws") are **NOT** acceptable for permanently attaching the protection material (steel or steel mesh) to steel studs. Screws may be used to "tack" the sheets in place pending riveting or welding. Temporary screws do not need to be removed.

Welding (Permitted Method)

Steel mesh (Figure 2): 3mm fillet weld along the strand at 200mm oc

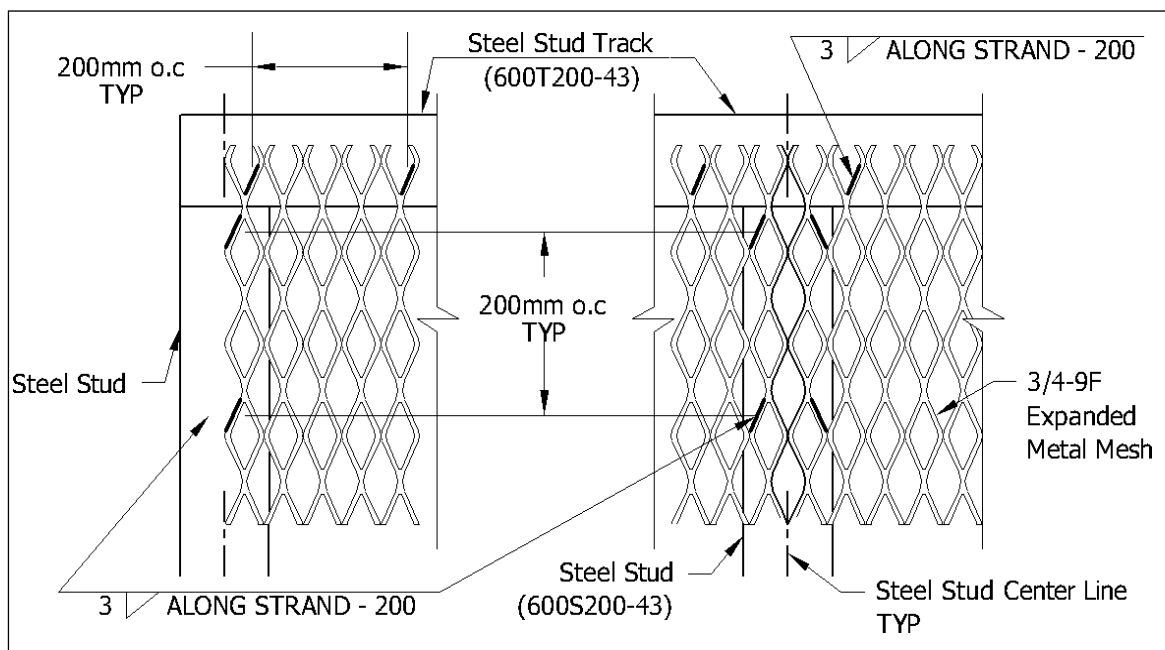


Figure 2: Welding Steel Mesh

Steel Sheet (Figure 3): 1.5mm fillet weld 15mm long at 200mm oc **or**
8mm plug weld at 200mm oc

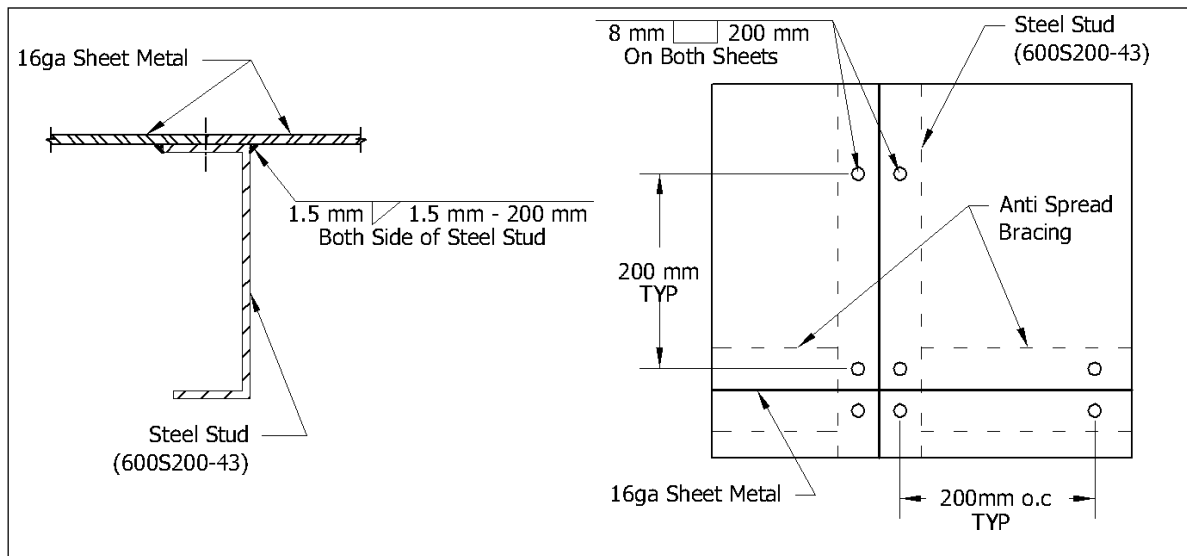


Figure 3: Welding Sheet Steel

Rivets (Preferred Method)

Steel sheet: 3/16" steel rivets at 200mm oc.

Steel mesh: 3/16" steel rivets and "fender" washer (1 1/2" OD, 3/16" ID) at 200mm oc.

Suggested material:

Rivets: 3/16" steel pop rivet: Speaneur part #301-440

Washers: 1 1/2" OD, 3/16" ID "fender" washer: Fastenal part #1133204

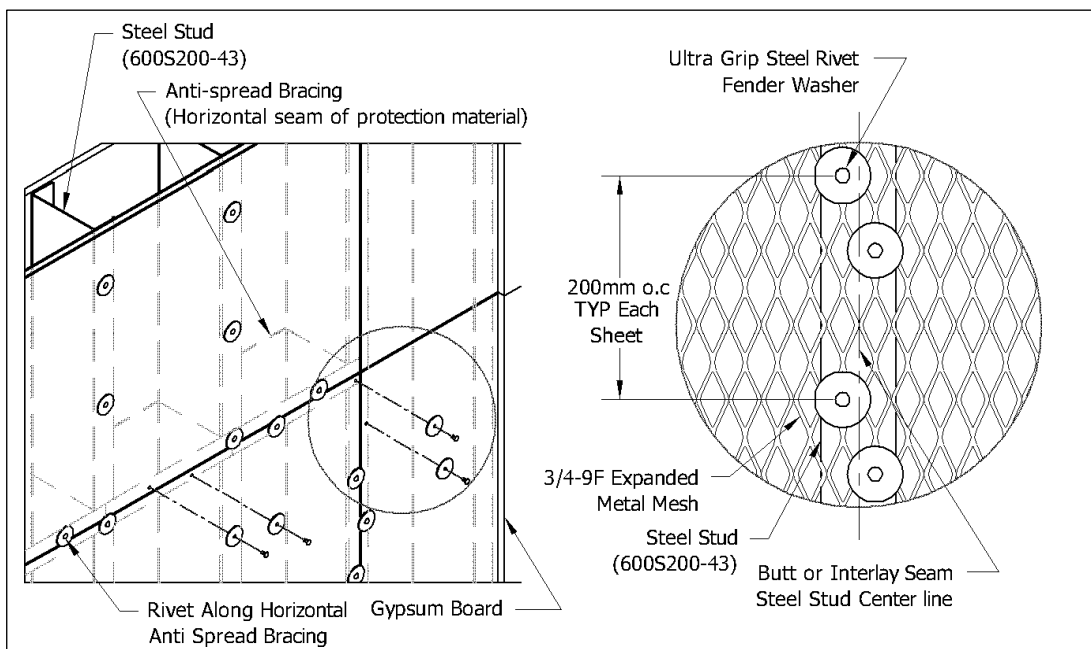


Figure 4: Riveting Sheet or Mesh



Figure 5: Example of Mesh Interlay Seam, Riveted

Critical Attack Area (Figure 6): 16 ga. (1.6 mm) steel sheet, HR Commercial quality, ASTM A366, matte finish, shall extend 1200mm around the door frame on the inside of the secure storage room and be attached as per selected rivet or welding requirements for protection material.

Note: Perforations for services, conduits or ducts are not permitted in the Critical Attack Area.

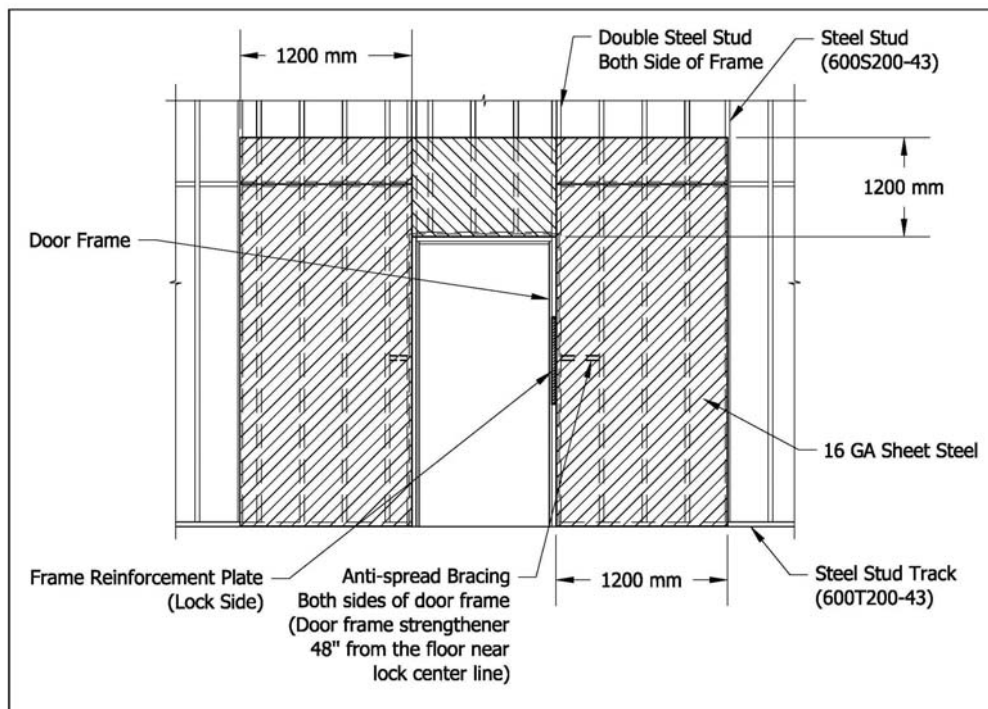


Figure 6: Critical Attack Area Wall Reinforcement

Wall Finishing Details

Install 16mm gypsum wall boards on both sides of the wall (interior is optional).
Standard drywall screws are acceptable for attaching the drywall.

Apply continuous bead of fire-rated acoustic sealing on both sides of the top and bottom tracks.
ASTM E814 (UL1479), ASTM E1966 (UL 2079) or CAN/ ULC S115 test standards with a fire/ smoke rating acceptable to the Authority Having Jurisdiction (AHJ).

Paint exterior surface of wall with one coat primer/sealer and one coat of gloss enamel.
Primer/sealer must extend above drop ceilings to the bottom of structural ceiling. Paint must be uniform and without blemishes. Joints must not be visible. Custom colors should be considered.

Door, Frame and Hardware

Door and Frame – Commercial Steel Door and frame compliant with section 08-11-13 of CDMA Publication: *Recommended Specification for Commercial Steel Door and Frame Products*.

Door may be specified as fire rated where required.

Doors wider than 900mm (36”) should be avoided. Double doors will require special measures.

Door:

Face Gauge: 16 gauge (1.6 mm) steel

Construction: Laminated core with vertical steel stiffeners at 150mm oc (stiffeners welded or laminated to each face sheet with voids between stiffeners filled with fiberglass or mineral batt type material).

Caps: ‘Flush Closing Channel’ or ‘Flush Channel’ top and bottom.

Ref: NAAMM 810-09 Part 2. A. Figures E and F for edge details.

Edges: all edges and top and bottom caps to be continuously welded and ground smooth.

Door handing: (must be specified as per client requirements).

Frame:

Gauge: 16 gauge (1.6mm) steel

Frame construction: Welded or fully field welded 3-piece “knock-down” (for retrofit applications).

Anchors: “Z” shape steel wall anchors welded to frame.

Reinforcing at latch: as per lock manufacturer recommendations. Lock specifications must be provided to the supplier/manufacturer to provide necessary reinforcing requirements.

Locks: Select according to Table 1.

Hinges: to ANSI/BHMA A156.1 Grade 2 and ANSI A8112 (Steel Material Standard) Full mortise, five knuckles, ball bearings, standard weight. Three (3) hinges per door (minimum).

Minimum Dimensions: 114mm (4 ½”) x 114mm (4 ½”) x 3.4mm (0.124”) thick.

Hinges mounted with barrels on the attack side (“reverse-hung” or outwards opening) must have non-removable pins (NRP), maximum security pins (MSP) or safety studs/reverse safety studs. Note that these require special ordering instructions.

Suggested products:

- Hager (<http://www.hagerco.com>) Catalogue item BB1279
- Stanley Architectural Hardware (www.stanleyhardware.com) Catalogue item FBB179
- Mont-Hard (Canada).. Mont-Hard products are carried by Montreal Hinge (www.montrealhinge.com). Catalogue item BB-1079

Door closer: Overhead style ANSI A156.4 Grade 1

Suggested product: Ingersol-Rand LCN 4040 series

Threshold: Aluminum (or other metal) interlocking style with hook strip installed on door. The SSR should qualify for exception from building code “Barrier-free path” requirements when used only to store records. However, where wheelchair accessibility is required, two recommended products are:

- PEMKO (model 114): PEMKO (Toronto) 866-243-9816 (sales), www.PEMKO.com
- Zero International (model 73A): www.Zerointernational.com

Door contacts: UL 634 High Security Switch - level 1 or level 2.

Door installation:

The door is generally installed as regular hung (opening into the Secure Storage Room), but it can be reverse hung (opening out) in exceptional cases.

Frame reinforcement at the lock area: (Figure 7)

Secure a 6.4mm x 25mm x 610mm steel plate inside the frame using tack welds on every edge. Align the centre of the plate with the lock bolt.

For reverse hung doors, install a steel astragal covering the entire lock edge of the door AND the unmodified¹ strike plate. The astragal should be at least 14 ga (2 mm) thick, should overlap the door frame by at least 25mm. Attach with minimum 6mm (1/4") diameter steel carriage bolts spaced at 250mm oc and at least 25mm from mortise lock pocket. Carriage bolt heads must be on the attack side.

Suggested product: Zero International #43STST

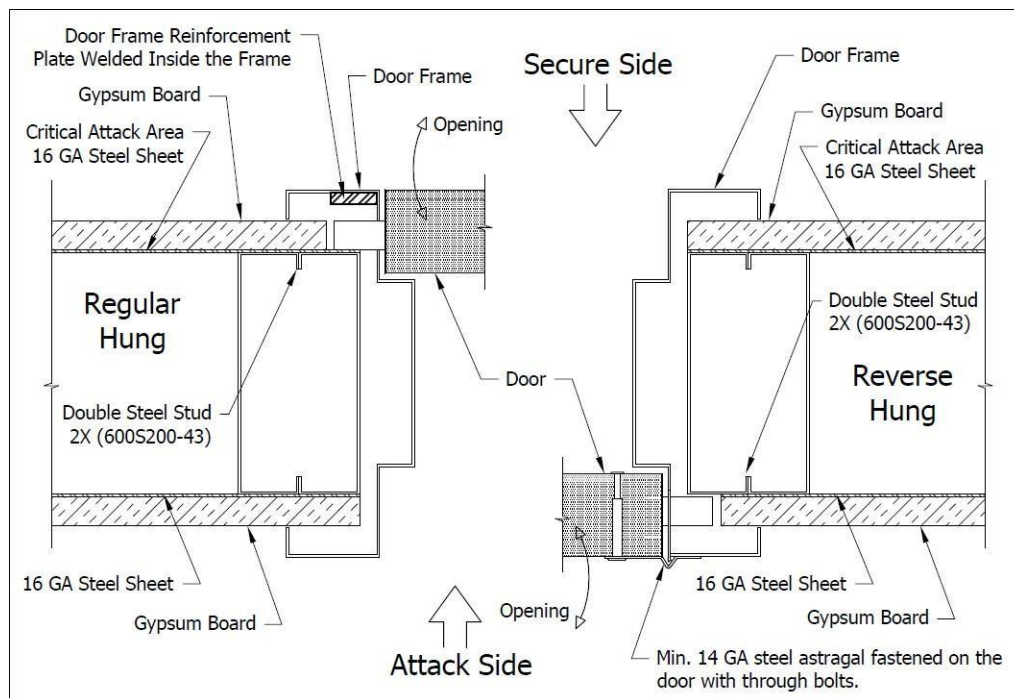


Figure 7: Frame Reinforcement at Door

Ventilation Duct Pass-throughs

Note: Where superior resistance to cutting is required, security bars can be specified as tool-resistant steel (grade 1 or 2) per ASTM A627.

Ceiling mount: (Figure 8)

1. Duct sleeve to be at least the same thickness as duct passing through.
2. The overall dimension of the sleeve must be slightly greater than the duct.
3. Construct frames of 1- 3/8" x 1- 3/8" x 1/8" angle steel welded around duct sleeve (ceiling mount brackets are recommended).
4. Space 3/8" Ø steel security bars at 6" oc and weld to the frame.
5. Secure the duct sleeve to the structural ceiling with mechanical fasteners.

¹ The leading (curved) edge of the strike plate is essential to the correct operation of the lock and must not be cut.

6. Cut protection material $\frac{3}{4}$ " max from the edge of the duct opening (3 sides)
7. Apply fire-rated caulking between duct sleeve and finished wall.

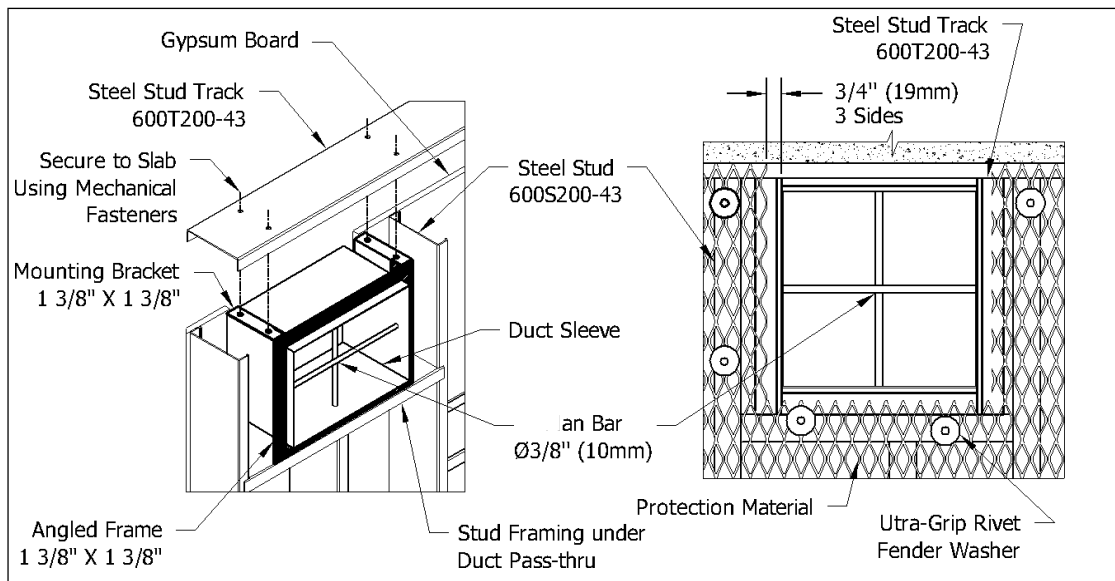


Figure 8: Ceiling Mount Duct Pass-Through

Surface Mount: (Figure 9)

1. Duct sleeve to be at least the same thickness as the duct passing through.
2. The overall dimension of the sleeve must be slightly greater than the duct.
3. Construct frame on each side of the wall of 1- $\frac{3}{8}$ " x 1- $\frac{3}{8}$ " x $\frac{1}{8}$ " angle steel welded around duct sleeve.
4. Space $\frac{3}{8}$ " $\varnothing$ steel security bars at 6" oc and weld to the frame.
5. Secure duct sleeve with $\frac{1}{4}$ " dia bolts and hex nuts (inside the room) at 8" oc around the outside duct sleeve. The bolt head shall be on the attack side and be welded in at least three places to the angle frame.
6. Framing around duct sleeve is required.
7. Apply fire-rated caulking between duct sleeve and finished wall.

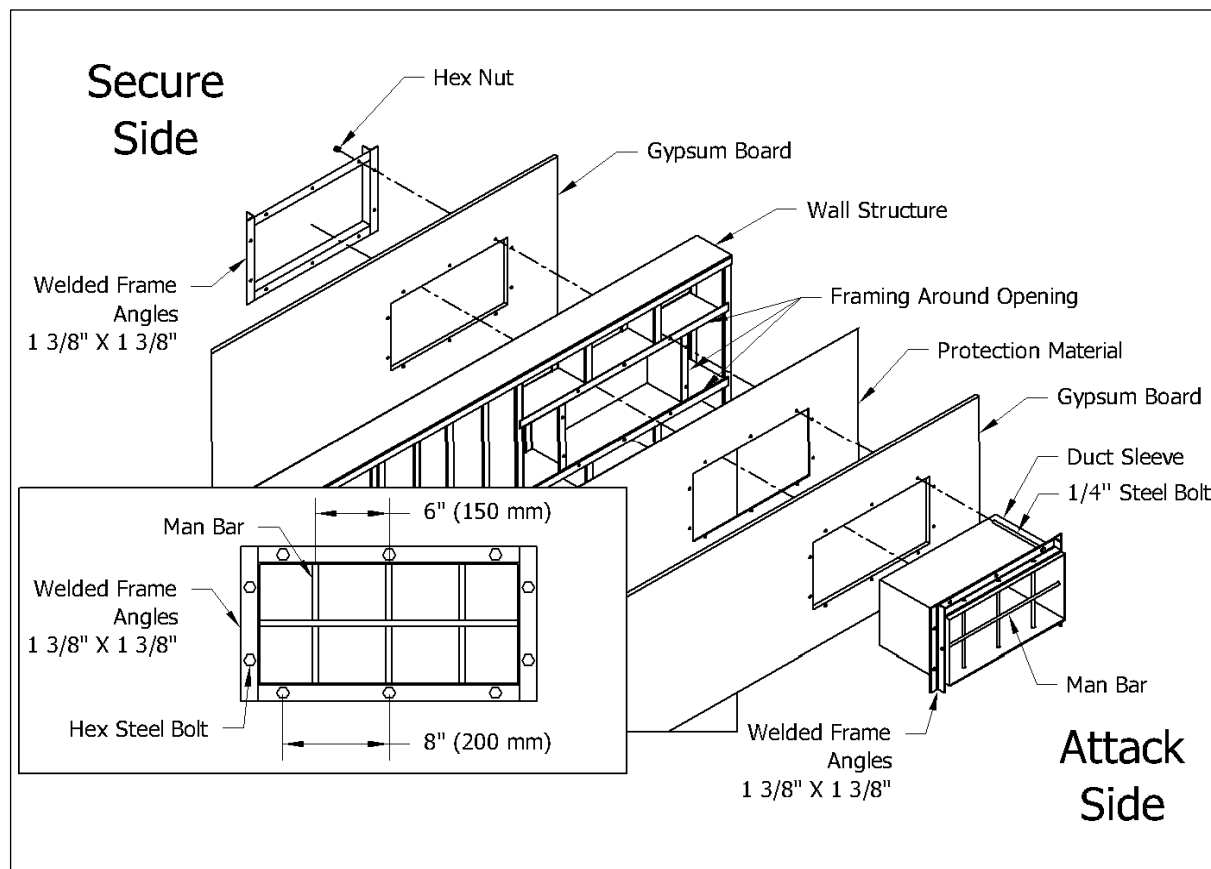


Figure 9: Surface Mount Duct Pass-Through

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 99 – Painting.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

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 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 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 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.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

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 incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with DCC Representative before final inspection.
 - .2 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.
- .3 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.
- .4 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.
- .5 Approvals:
 - .1 Submit one (1) electronic copy of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .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.
- .8 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 DCC Representative for approval and make corrections as directed.
 - .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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 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 in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 All materials and equipment used on this project shall be new and CSA approved.

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 installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative 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 DCC Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Submit tests as specified in other sections of this specification.
- .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 - ACTION AND INFORMATIONAL 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.

3.5 DEMONSTRATION

- .1 DCC Representative 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.
- .5 DCC Representative will record these demonstrations on video tape for future reference.

3.6 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.

3.7 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies the Contractor's responsibilities related to commissioning of fire suppression systems and their contribution to the overall commissioning work specified in relevant Sections of Division 01.
- .2 Construction Team: Contractor is responsible for performing tests and verification activities specified in the relevant Sections of Division 21, and submitting reports to Commissioning Authority.
 - .1 Subcontractors: fire suppression Subcontractors and third-party inspection/testing agencies participate in commissioning activities in coordination with site quality control requirements for Work they are providing.
 - .2 Manufacturers: manufacturers assist verification activities and report on installation, performance and operation of the products/systems they supplied, as specified in relevant Sections of Division 21.
 - .3 Contractor coordinates the work of Subcontractors, inspection/testing agencies and manufacturers with the commissioning requirements of this Section.
- .3 Commissioning Authority (CxA): the CxA may assign a commissioning specialist with expertise in building mechanical systems and controls, to undertake his commissioning responsibilities related to this Section.
- .4 DCC Representative will designate a person to represent the interests of the facility related to work specified in the relevant Sections of Division 21.
 - .1 O&M Representative: DCC Representative may designate an additional representative to participate in the commissioning process and facilitate the transfer of fire suppression systems to the facility's O&M staff.
- .5 The requirements of this Section do not replace testing requirements specified in the relevant Sections of Division 21 or reporting activities to demonstrate compliance with building code requirements to the authorities having jurisdiction.

1.2 RELATED REQUIREMENTS

- .1 Section 25 01 11 - EMCS: Start-up, verification and commissioning.
- .2 Section 26 08 00 - Commissioning of Electrical Systems.

1.3 ACRONYMS

- .1 BMM - Building Management Manual
- .2 CT - Construction Team
- .3 Cx - Commissioning

- .4 CxA - Commissioning Authority
- .5 EMCS - Energy Monitoring and Control Systems
- .6 FPT - Functional Performance Testing
- .7 O&M - Operation and Maintenance

1.4 DEFINITIONS

- .1 Construction Team: the term Construction Team is used in this Section to designate inclusively the Contractor, Subcontractors, manufacturers/suppliers and other support disciplines that are responsible for construction/installation of the Work specified in these specifications.
- .2 Cx Forms: forms used to document the inspections, tests and verification activities performed during the commissioning process, as specified in Section 01 91 13 - General Commissioning Requirements.
- .3 Cx Plan: a document developed under the responsibility of the CxA to specify the project's commissioning requirements, as specified in Section 01 91 13 - General Commissioning Requirements.
- .4 Cx Team: the commissioning team consists of project members that participate in the development, refinement and execution of the Cx Plan, as specified in Section 01 91 13 - General Commissioning Requirements.

1.5 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA Z320-11, (R2021), Building Commissioning.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Construction Team Cx Representative: Contractor to designate a person from the Construction Team to review and coordinate commissioning activities specified in this Section.
 - .1 Representative to be acceptable to CxA with the following qualifications:
 - .1 Technical personnel testing and commissioning of fire suppression systems.
 - .2 An employee of the Subcontractor installing the fire suppression systems, with direct knowledge of the installation.
- .2 Coordination: coordinate the responsibilities of the Construction Team in the Cx process with the responsibilities of other participants that form part of the Cx Team.
 - .1 Coordinate the participation of fire suppression Subcontractors, inspection/testing agencies and manufacturers in reviewing the Cx Plan, submittals and in assisting testing and demonstration activities related to their work.
 - .2 Coordinate commissioning activities with execution of the work during the course of construction to allow Cx participants and the authority having jurisdiction to fulfill their

- responsibilities for witnessing tests and reviewing installation before concealment of work.
- .3 Coordinate with Section 26 08 00 - Commissioning of Electrical Systems for electrical distribution serving fire suppression equipment including disconnects, starters and line-voltage devices.
- .4 Coordinate with Section 25 01 11 - EMCS: Start-up, verification and commissioning for integrating fire suppression equipment with the building's EMCS and fire alarm systems.
- .3 Notification: notify the CxA of activities associated with the commissioning process in accordance with Section 01 91 13 - General Commissioning Requirements.
- .4 Commissioning Conferences: arrange commissioning meetings attended by DCC Representative, CxA, Contractor and fire suppression Subcontractors in accordance with Section 01 91 13 - General Commissioning Requirements and as follows:
 - .1 Before starting work: to review mock-up requirements and factory testing of systems, components and/or equipment.
 - .2 Coordination of integrated systems: to review and coordinate interfaces of fire suppression equipment and control devices to ensure they connect with systems specified in the relevant Sections under Divisions 25 and 28.
 - .3 During execution of work but before start of commissioning activities: to refine the Cx Plan, commissioning documentation and the commissioning schedule.
- .5 Sequencing: perform commissioning activities in general accordance with the commissioning process described in CSA Z320, maintaining the systematic approach to completing and obtaining acceptance for each phase of commissioning in particular with regards to static verification, start-up and functional performance testing.
 - .1 Functional Performance Testing (FPT): perform operational and performance testing by phases starting with individual components and equipment, testing of sub-systems and then proceeding to FPT of overall systems.
 - .2 Integrated Systems: only perform commissioning of integrated systems once the FPT for each individual system forming part of the integrated system has been completed.
 - .3 Demonstration and training activities may form part of certain commissioning activities, as agreed by CxA.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Fire Suppression Cx Schedule:
 - .1 Submit proposed schedule before start of commissioning conferences indicating key activities critical to the commissioning process including:
 - .1 Inspection of fire suppression systems.
 - .2 Testing, flushing and cleaning of fire suppression piping.
 - .3 Commissioning phases: static verification, start-up, functional performance testing, systems orientation, O&M manuals submissions, training sessions.
 - .4 Integrated testing activities.

- .5 Review activities to be completed by other participants: DCC Representative, CxA and the authority having jurisdiction.
- .2 Review the proposed schedule through the course of the work and notify the CxA of modifications required.
- .3 Commissioning Forms: Contractor to review and complete forms for documenting static verification and start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.
 - .1 Approved Cx Forms: CxA and authority having jurisdiction (AHJ) review and approve the final format to use through the commissioning process.
 - .1 Submit preferred forms format for review by the CxA and the AHJ. This may include manufacturer provided checklists.
 - .2 Submit completed static verification and start-up checklists within 48 hours of completion of verification of equipment or system.
- .4 Testing Equipment: Submit a list of proposed testing equipment for performing fire suppression Cx activities and related tests in accordance with Section 01 91 13 - General Commissioning Requirements.
- .5 Site Quality Control Submittals: submit manufacturers' written certificates and reports demonstrating compliance of Work, as specified in the relevant Sections of Division 21.
- .6 Training Program: Submit proposed training program and materials in accordance with Section 01 79 00 - Demonstration and Training for Building Commissioning and Section 01 91 13 - General Commissioning Requirements.

1.8 CLOSE OUT SUBMITTALS

- .1 Submit O&M data and as-built information in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Site Modifications: record changes to installations, system configuration and/or controls that were made during the commissioning process to meet the required performance of fire suppression equipment and systems.

Part 2 Products

2.1 EQUIPMENT

- .1 Furnish special tools or equipment required for:
 - .1 Verifying or adjusting equipment/system components.
 - .2 Accessing equipment, enclosures or control cabinets.
 - .3 Interfacing with equipment controls or integrated system diagnostics.
- .2 Furnish instruments and equipment required to perform testing and validate performance of fire suppression systems through the commissioning process or as specified in relevant Sections of Division 21.

Part 3 Execution

3.1 STATIC VERIFICATION

- .1 Perform static verification of components, equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Verify installation and connection of equipment, sub-systems and systems.
 - .2 Confirm proper location of valves, switches, sprinklers, fire extinguishers, and control components in accordance with design and O&M requirements.
 - .3 Confirm accessibility to fire suppression equipment and components for inspection and O&M activities.
 - .4 Conduct hydrostatic pressure testing of fire suppression piping and report results.
 - .5 Record equipment and systems information including: manufacturer, model number, serial number and rated capacities.
 - .6 Confirm completion of labelling and identification of piping, valves, equipment, and control components as per design and local code requirements.
 - .7 Confirm completion and documentation of equipment prestart-up tests, including manufacturer's factory tests.
 - .8 Confirm adequate protection of fire suppression systems during construction.
 - .9 Confirm seismic and vibration controls for fire suppression equipment/systems are installed in accordance with design details and manufacturer's recommendations.
- .2 Site Quality Control: CxA to conduct random verification on-site to validate the accuracy of static verification reporting. Contractor to assist the CxA on site to review selected samples representing up to 50% of the overall installation.

3.2 START UP

- .1 Start-up requirements described in this Section do not replace start-up activities required by local codes or specified in relevant Sections of Division 21.
- .2 Perform start-up of equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Flushing and cleaning of fire suppression piping.
 - .2 Contractor/manufacturer start-up of equipment.
 - .3 Electrical start-up including site electrical tests and verification of overloads and motor rotation.
 - .4 Test flow capacity and alarm functions of fire pumps.
 - .5 Test operation of every supervisory device including valve supervisory switches, flow alarm switches and pressure alarm switches.
 - .6 Visual and mechanical inspections following equipment start-up.
 - .7 Verify operation of safety controls and interlocks.
 - .8 Complete inspections required by authorities having jurisdiction.

- .9 Test complete systems in accordance with ULC requirements.
- .3 Site Quality Control: CxA and the authority having jurisdiction will witness start-up activities for selected equipment. Notify the CxA and authority having jurisdiction of start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- .1 Functional Performance Testing (FPT) described in this Section does not relieve the Contractor of his responsibilities for performing tests required by local codes or specified in relevant Sections of Division 21.
- .2 Perform FPT on fire suppression equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and as directed by the CxA.
- .3 Coordinate FPT activities with testing required by the AHJ and schedule a mutual agreed time to conduct and witness applicable tests in the site.
- .4 FPT activities to include:
 - .1 Verifying proper operation of fire suppression systems in the following modes of operation:
 - .1 System on normal power.
 - .2 System on emergency power.
 - .3 Normal operation - no alarm conditions.
 - .4 System in alarm condition.
 - .5 Manual operation mode.
 - .6 Automatic operation mode.
 - .2 Verifying operation of safety cutouts, alarms and interlocks.
 - .3 Confirming remote alarm notifications are generated and received, or sent via a communications system.
 - .4 Confirming proper operation of level controls for fire protection systems involving storage tanks and/or cisterns.
 - .5 Confirming proper integration of fire suppression equipment with the fire alarm system.

3.4 CX OF INTEGRATED SYSTEMS

- .1 Operate equipment as directed by CxA to perform commissioning of integrated systems.

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: obtain written certificates and reports from manufacturer verifying compliance of Work and submit Manufacturer's Site Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Provide manufacturer's site services to complete start-up activities and assist in Functional Performance Testing as specified in relevant Sections of Division 21.

3.6 CLOSEOUT ACTIVITIES

- .1 Corrections: Provide equipment, materials and labor as required to correct installation and/or equipment deficiencies identified through the commissioning process.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.

1.2 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA):
 - .1 NFPA 13-2025, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 25-2026, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .2 ULC Standards (ULC):
 - .1 CAN/ULC-S543-09, Standard for Internal Lug Quick Connect Coupling for Fire Hose.
 - .2 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

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 literature and data sheets for equipment and systems, applicable series designation or style. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .2 Submit WHMIS Safety Data Sheets (SDS).
- .3 Shop Drawings: Submit drawings stamped and signed by a professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples: Submit samples of the following:
 - .1 Each type of sprinkler head.
 - .2 Signs and valve tags.
- .5 Test Reports:
 - .1 Test hydrostatically to meet requirements of fire protection system to which it will be connected.
- .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Submit manufacturer's installation instructions if available.

- .8 Site Quality Control Submittals: Submit site reports showing system complies with NFPA 13, NFPA 25, and CAN/ULC-S1001.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data and incorporate into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Submit detailed hydraulic calculations including: summary sheet, Contractor's Material and Test Certificate for above-ground and underground piping, as well as other deliverables. Incorporate into operations and maintenance manual in accordance with NFPA 13.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Company or person specializing in dry pipe sprinkler systems with documented experience and approved by manufacturer.
 - .2 Manufacturer: Supply grooved joint couplings, fittings, valves, grooving tools, and specialties from a single manufacturer.
- .2 Use date stamped castings for coupling housings, fittings, and valve bodies for quality assurance and traceability.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Supply spare sprinklers and tools in accordance with NFPA 13.

1.7 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:
 - .1 Deliver materials to site in original factory packaging with manufacturer's labels.
- .3 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Design system in accordance with NFPA 13 using the following parameters:

- .1 Hazard:
 - .1 To suit occupancy as indicated.
- .2 Pipe size and layout:
 - .1 Hydraulic design.
 - .2 Sprinkler head layout: to NFPA 13.
- .3 Water Supply:
 - .1 Conduct flow and pressure test of water supply in vicinity of the project to obtain criteria for basis of design in accordance with NFPA 13.
- .4 Zoning:
 - .1 System zoning as indicated.

2.2 PIPE, FITTINGS, AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13.
 - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: Screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, flush seal gasket for dry service, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper Tube: Screwed, soldered, brazed or grooved.
- .3 Auxiliary Valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, grooved, OS & Y gate.
 - .3 NPS 2 1/2 and over: cast or ductile iron, flanged or roll grooved ends, indicating butterfly valve.
 - .4 Swing or spring-actuated check valves.
 - .5 Ball drip.
 - .6 Tamper devices wired back to fire alarm panel.
- .4 Pipe Hangers: ULC listed for fire protection services.

2.3 SPRINKLER HEADS

- .1 General: To NFPA 13 and ULC listed for fire services.
- .2 Type A: Upright bronze.
- .3 Type B: Pendant chrome glass bulb semi-recessed type.
- .4 Type C: Pendant chrome glass bulb type.
- .5 Type D: Recessed polished chrome glass bulb type with ring and cup.

- .6 Type E: Concealed glass bulb type with cover to match ceiling finish.
- .7 Type F: Side wall polished chrome glass bulb type.
- .8 Provide escutcheons or cover plates for sprinklers to match sprinkler head finish.
- .9 Provide guards for sprinklers in the following rooms:
 - .1 Water room
 - .2 Electrical room
 - .3 IT
 - .4 CAD Area

2.4 AUXILIARY SUPERVISORY SWITCHES

- .1 General: To NFPA 13 and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.5 FIRE DEPARTMENT CONNECTION

- .1 To NFPA 13 and ULC listed, Siamese type. Thread specifications compatible with local fire department. Internal lug quick connect to CAN/ULC-S543.
- .2 Exposed design, threaded metal caps and chains, with identifying sign with cast letters on plate.
- .3 Polished bronze chrome plated.

2.6 PRE-ACTION /DELUGE ALARM VALVE

- .1 ULC listed.
- .2 Cast or ductile iron, flanged or grooved-end type, sized to suit water main.
- .3 Components:
 - .1 Accelerator.
 - .2 Air maintenance device with low pressure alarm.
 - .3 Alarm pressure switch with supervisory capability.
 - .4 Test valve and associated piping.
 - .5 Drain valve.

- .6 Electrical tripping device.
- .7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.
- .4 Provide valve with internal components that are replaceable without removing valve from installed position.

2.7 COMPRESSED AIR SUPPLY

- .1 Automatic Air Compressor.
- .2 ULC listed.
- .3 Capacity:
 - .1 To restore normal air pressure in system within 30 minutes.
 - .2 To provide air pressure of 140 kPa in excess of calculated trip pressure of dry pipe valve in accordance with instruction sheet associated with dry pipe valve.
- .4 Piping: Ferrous, NPS 3/4 screwed joints and fittings, to NFPA 13.

2.8 PRESSURE GAUGES

- .1 ULC listed and to Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Maximum limit of not less than twice the normal working pressure at installation point.

2.9 RELIEF VALVE

- .1 ULC listed.

2.10 SPARE PARTS CABINET

- .1 For storage of maintenance materials, spare sprinkler heads, and special tools.
- .2 Construct to sprinkler head manufacturer's standard.

Part 3 Execution

3.1 INSTALLATION

- .1 Install, inspect, and test to acceptance in accordance with NFPA 13 and NFPA 25.
- .2 Install fire department connections as indicated.
 - .1 Install a 90° elbow with drain connection at low-point near each fire department connection to allow for system drainage to prevent freezing.
- .3 Install spare parts cabinet where directed by DCC Representative.
- .4 Pressure Gauges:

- .1 Locations:
 - .1 On water side and air side of dry pipe valve.
 - .2 At air receiver.
 - .3 In each independent pipe from air supply to dry pipe valve.
 - .4 At exhausters and accelerators.
- .2 Install to permit removal.
- .3 Locate where not susceptible to freezing.
- .5 Valve Identification:
 - .1 Identify drain valve, by-pass valves, main shut-off valve, and all auxiliary valves.

3.2 SITE QUALITY CONTROL

- .1 Perform site tests in accordance with NFPA 13 and NFPA 25.
- .2 Perform integrated systems testing of fire protection and life safety systems in accordance with CAN/ULC-S1001.
- .3 Tests will be witnessed by the AHJ, Canadian Forces Fire Marshal (CFFM) and DCC Representative.

3.3 CLEANING

- .1 Perform cleaning in accordance with Section 01 74 00 - Cleaning.
- .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 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B1.20.1-83(R2001), Standard for Pipe Threads, General Purpose.
 - .2 ANSI/ASME B16.3-2006, Malleable Iron Threaded Fittings Classes 150 and 300.
 - .3 ANSI/ASME B16.9-01, Factory Made Wrought Butt welding Fittings.
 - .4 ANSI/ASME 2004 Boiler and Pressure Vessel Code - Section IX, Welding and Brazing Qualifications.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-04, Power Piping.
- .3 ASTM International (ASTM)
 - .1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
 - .2 ASTM A 106/A 106M-06a, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - .3 ASTM A 197/A 197M-00(R2006), Standard Specification for Cupola Malleable Iron.
 - .4 ASTM A 234/A 234M-07, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 2001-2025, Standard on Clean Agent Fire Extinguishing Systems.
 - .2 NFPA 70-2026, National Electrical Code.
- .5 Underwriters' Laboratories Inc. (UL) - Fire Protection Equipment Directory-2002
 - .1 UL 1058-2006, Standard for Halogenated Agent Extinguishing System Units.
 - .2 UL 2166-99, Standard for Halocarbon Clean Agent Extinguishing Systems Units.
- .6 U.S. Department of Transportation (DOT) - Title 49 Code of Federal Regulations Parts 100 to 199, Transportation of Hazardous Material.
- .7 Canadian Standards Association (CSA)
 - .1 CSA 22.1 Canadian Electrical Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit product data for the following:
 - .1 Storage cylinders.

- .2 Control valves and pilot controls.
- .3 Control panels.
- .4 Nozzles.
- .5 Push button stations.
- .6 Detectors.
- .7 Alarm bells or horns.
- .8 Switches.
- .9 Annunciators.
- .3 Provide 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 Province of Ontario, Canada.
 - .1 Submit shop drawings indicating:
 - .1 Detailed layout of system.
 - .2 Component descriptions and locations.
 - .3 Control diagrams.
 - .4 Wiring diagrams.
 - .5 Written sequence of operations.
 - .2 Submit electrical schematics and piping diagrams describing complete suppression system.
- .4 Submit test reports for the following:
 - .1 Room integrity tests.
 - .2 Pressure test.
 - .3 Flow test.
- .5 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Nozzle.
 - .2 Signs and valve tags.
- .6 Quality Control Submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout Submittals:
 - .1 Electrical schematic of circuits.
 - .2 Written description of system design.
 - .3 Drawings illustrating control logic and equipment location.
 - .4 Written documentation for:
 - .1 Emergency procedures.
 - .2 Abort functions.
 - .3 System control panel operation.

- .4 Trouble procedures.
- .5 Safety requirements.

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design system in accordance with NFPA 2001:
 - .1 Hazard: to suit occupancy as indicated.
 - .1 Hazard: as indicated.
 - .2 Submit design calculations for following:
 - .1 System terminal pressures.
 - .2 Nozzle flow rates.
 - .3 Orifice code number.
 - .4 Piping pressure losses.
 - .5 Component flow data.
 - .6 Pipe sizes.
 - .7 Minimum design concentration.
 - .8 Minimum design agent quantity.
 - .9 Actual agent quantity.
 - .10 Highest expected actual concentration.
 - .11 Discharge time.
 - .12 Concentration hold time.
 - .13 Enclosure pressure venting.
 - .3 Submit schematics and diagrams describing suppression system and interface with building system.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - .3 Store materials protected from weather conditions and at temperature conditions recommended by manufacturer.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 WARRANTY

- .1 Warranty system for parts and labour for not less than a period of 12 months from date of installation.

- .2 False Discharge Warranty: Warranty replacement and associated costs of clean agent in event of false discharge attributable to defects in installation or parts for a period of 12 months from date of installation.
- .3 Warranty capability to recondition complete system within 24 hours in event of system activation.

1.6 COMMISSIONING

- .1 Upon acceptance, system shall be conditions and placed in operation.

1.7 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance data for system and components for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Provide spare parts as follows:
 - .1 2 nozzles.
- .2 Maintenance Service:
 - .1 Provide regular maintenance service to system in accordance with clean agent manufacturer's written recommendations and maintenance manual for a period of 12 months.
 - .2 Inspection personnel: authorized by clean agent manufacturer.
 - .3 Inspect system 6 months and 12 months after installation.
 - .4 Conduct inspections in accordance with manufacturer's guidelines and recommendations of NFPA 2001.
 - .5 Inspections include but are not necessarily limited to:
 - .1 Determination of clean agent contents and pressure.
 - .2 Proper working order of control, detection and alarm systems.
 - .6 Submit documents certifying satisfactory system conditions after inspections.

Part 2 Products

2.1 SUPPRESSION AGENT

- .1 Suppression Agent:
 - .1 NFPA Designation: FK-5-1-12.
 - .2 Trade name: Novec 1230.

2.2 AGENT STORAGE

- .1 Capacity: Determined by supplier in high pressure seamless steel alloy cylinder.
- .2 Provide one full set of spare charged cylinder.
- .3 Standard:

- .1 Manufactured, tested and marked in accordance with DOT Specification 4BW500, 4BA500, 3AA, 3A.
- .2 In accordance with suppression agent manufacturer.
- .4 Cylinder Assembly:
 - .1 Pressure seat type valve equipped with gauge.
 - .2 Cylinder pressure supervisor switch to provide a signal at the control panel if the pressure in the cylinder drops to 2206 kPa.
 - .3 Protective cap: threaded steel anti-recoil.
 - .4 Installation: free standing steel racks on solid walls.
 - .5 Lifting lugs: cylinders larger than 97 kg with lifting lugs.
 - .6 Brackets: integral brackets to be provided for secure mounting.
 - .7 Discharge Valve:
 - .1 Material: machined brass forging.
 - .2 Design: pressure seated, high flow rate design incorporating brass piston with seal, pressure releasing for valve operation, safety disc assembly, pressure actuation outlet port and pressure gauge.

2.3 RELEASING DEVICE

- .1 Detection: to signal automatic release and/or alarm by optical type smoke detectors and/or heat (rate compensated) detectors signalling control panel.
- .2 Alarms:
 - .1 Type: horn/strobe.
 - .2 Locations:
 - .1 To alert personnel located in protected areas.
 - .2 At entrances to protected areas.
- .3 Operation:
 - .1 Automatic release solenoid-operated valve on cylinder valve that causes discharge of agent storage containers in system.
 - .2 Program control panel to provide adequate pre-discharge alarm period at time of system test to ensure personnel safety.
- .4 Supervision: each releasing device separately series supervised and activated by output directly from control panel.
- .5 Features:
 - .1 Releasing device: removable from container valve without emptying container.
 - .2 While removed from container valve, releasing device capable of being operated, with no replacement of parts required after this operation.

2.4 MANUAL OVERRIDE

- .1 Manual lever actuator for override applications.

2.5 CHECK VALVE

- .1 For each cylinder connected to common manifold.

2.6 TRANSFER SWITCH

- .1 Operation: manual.

2.7 SELECTOR VALVE

- .1 Operation:
 - .1 Pressure operated and self restoring.
 - .2 Released by pilot operators which can be operated directly, by remote pressure source and/or electric solenoid.

2.8 PRESSURE REDUCER

- .1 Orifice plate:
 - .1 Stainless steel.
 - .2 Orifice size as required.

2.9 AUXILIARY SWITCHES

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service
 - .1 Type:
 - .1 Normally open and normally closed contacts with supervisory capability, pressure operated upon release of clean agent into discharge piping.
 - .2 Heavy duty, double pole, single throw, two to unit.
 - .3 Complete with manual operator for test and reset.
 - .2 Signal:
 - .1 Shut down of electric power to ventilation system.
 - .2 Shut down of electric powered equipment within hazard.
 - .3 Alarm.

2.10 PRESSURE OPERATED RELEASES

- .1 Function: to release self-closing devices operating doors, dampers, windows, louvers, lids, valves.

2.11 DISCHARGE NOZZLES

- .1 Coverage: in accordance with NFPA 2001.
- .2 Size: as required.
- .3 Dispersion pattern: 180 or 360 degrees as required.

- .4 Material: aluminum or brass corrosion resistant construction and specifically designed for specified clean agent application.
- .5 Markings: permanently marked as to type, part number and orifice size.
- .6 Pipe thread: standard thread corresponding to nozzle size for attachment to discharge piping.
- .7 Standards: UL listed

2.12 DISTRIBUTION PIPE AND FITTINGS

- .1 Material: Galvanized steel in accordance with NFPA 2001.
- .2 Pipe wall thickness: to ASME B31.1.
- .3 Pipe junctions:
 - .1 50 mm and smaller: threaded.
 - .2 Greater than 50 mm: welded or grooved.
- .4 Piping design:
 - .1 To NFPA 2001.
 - .2 Routing: layout piping to give maximum flow and to avoid possible mechanical, chemical or other damage.
- .5 Pipe threads: to ANSI B1.20.1.
- .6 Pipe reductions: butt weld concentric reducers, swaged nipples or weld-o-lets.
- .7 Screwed pipe reductions: screwed concentric reducing fittings or swaged nipples.
- .8 Non-corrosive pipe: hot-dipped galvanized inside and out.

2.13 PIPE SLEEVES

- .1 Sleeve piping through building walls, partitions, floor slabs, roof slabs.
- .2 Material: Schedule 40 steel pipe at two sizes (minimum) greater than pipe being sleeved.
- .3 Extend sleeves through floor slabs minimum 50 mm above floor.
- .4 Extend sleeves through roof slabs to permit clearance for roofing and flashing material.

2.14 PIPE HANGERS AND SUPPORTS

- .1 To ASME B31.1.
- .2 Hanger material: steel.

2.15 ACCESSORIES

- .1 Cylinder weighing:
 - .1 Provide rack uprights with weigh bar spanning rack for support of portable weighing device.
 - .2 Provide portable direct reading beam scale for weighing cylinders in place by loosening cylinder clamps and disconnecting discharge heads without disconnecting control components.
- .2 Cylinders: fit cylinders with capacity of 97 kg or more with liquid level indicating device.
 - .1 Provide graph to translate device reading to pounds of clean agent at cylinder temperature.

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 INSTALLERS

- .1 System components and accessories installed by personnel trained and certified by clean agent specified manufacturer.
- .2 Install, inspect and test to acceptance in accordance with NFPA 2001, NFPA 70.

3.3 INSTALLATION

- .1 General: to NFPA 2001.
- .2 In accordance with clean agent manufacturer's written instructions.
- .3 Install cylinders with service aisle for cylinder removal and cylinder weighing.

3.4 PIPING

- .1 Ream pipe after cutting to remove burrs and sharp edges.
- .2 Clean pipe before installation to remove foreign matter and oil from pipe.
 - .1 Pull wire brush through pipe lengths several times.
 - .2 Follow with clean cloth rags treated with a non-combustible metal cleaner designed for purpose.
- .3 Blow dry air through piping prior to installation of nozzles.
- .4 Treat with protective coating or galvanize pipe and fittings installed outdoors or in corrosive atmospheric area.

- .5 Install piping in accordance with layout design to provide maximum flow and to avoid possible mechanical, chemical or other damage.
- .6 Report deviations from pipe routing design to DCC Representative.
- .7 Pipe reductions: install reductions to permit full flow. Entrance holes from main pipe run to fitting to be of proper size and free of sharp edges, ridges or burrs.
- .8 Valve and Equipment Connections:
 - .1 Connect selector, check, solenoid valves with union immediately downstream.
 - .2 Connect valves having more than two connection points such as shuttle, pilot valves with a union adjacent to valve in each connection line.
 - .3 Connect equipment such as discharge delay devices, pressure switches with a union adjacent to equipment.
- .9 Pressure release piping and fittings: locate take-offs for pressure release piping from top of discharge piping.

3.5 PIPE HANGERS AND SUPPORTS

- .1 Fasten piping near nozzles to prevent pipe movement due to reaction force during discharge.
- .2 Install piping supports to prevent disengagement of supports by movement of supported pipe.
- .3 Solidly anchor pipe to structural members where longitudinal or lateral movements is possible.
- .4 Install rigid hangers wherever change in direction or change in elevation in piping system occurs.
- .5 Every other hanger: rigid on long straight runs.
- .6 Attach piping to rigid hangers by means of U-bolts locked with double nuts, one on each side of hanger.
- .7 Allow for longitudinal movement of pipe within U-bolt except where piping design requires pipe to be anchored.
- .8 Do not support pipe using other pipeline.
- .9 Arrange piping supports to prevent bending stresses from concentrated loads between supports.

3.6 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Test installation for correct operation and function.
 - .2 Provide requisite equipment, personnel, independent testing consultants to complete tests and provide written reports of results.
 - .3 Room Integrity:
 - .1 Standard: to NFPA 2001.

- .2 Test room integrity in accordance with testing consultant or clean agent manufacturer's written instructions using door fan method of room pressurization to determine leakage.
- .3 Provide a written test report to DCC Representative of results.
- .4 Correct deficiencies and retest.
- .4 Pressure Test:
 - .1 Pneumatically test system discharge piping in a closed circuit for a period of ten minutes at 2750 kPa.
 - .2 Pressure drop shall not exceed 20% of test pressure.
- .5 Flow Test:
 - .1 Perform flow test using nitrogen on the pipe network to verify that flow is continuous and that piping and nozzles are unobstructed.
 - .2 Install 'telldales' styrofoam cups over each nozzle that will easily blow off when nitrogen pressure reaches nozzle.
- .2 Manufacturer's Field Services:
 - .1 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.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.

3.8 DEMONSTRATION

- .1 Upon completion of installation provide 'hand-on' site review of system components and operation.
- .2 Functionally test system to demonstrate system components, system functions and recommended procedures for building maintenance personnel and DCC Representative.
- .3 Training to include but not necessarily limited to training for emergency procedures, abort functions, system control panel operation, trouble procedures and safety requirements.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 91 99 - Painting.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

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 and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify current model production.
 - .4 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

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 incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with DCC Representative before final inspection.
 - .2 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.

- .3 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.
- .4 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.
- .5 Approvals:
 - .1 Submit one (1) electronic copy of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .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.
- .8 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 DCC Representative for approval and make corrections as directed.
 - .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:

- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not used.

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 installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99 – Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
- .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 - ACTION AND INFORMATIONAL 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.

3.5 DEMONSTRATION

- .1 DCC Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Domestic hot water heater.
 - .2 Hot water recirculation pump.
 - .3 Condensate pumps.
 - .4 Plumbing fixtures.
- .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.
- .6 DCC Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal
 - .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 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of plumbing and related mechanical components and incidentals required to complete work described in this Section ready for new construction.

1.2 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .4 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, 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 (RSC 1985) including latest amendments.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Federal Workers' Compensation Service, Provincial Workers' Compensation Boards/Commissions.
 - .2 Government of Canada, Labour Program: Workplace Safety, Provincial Occupational Health and Safety Standards and Programs.

1.7 SITE 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.
- .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify DCC Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.
 - .2 Hazardous substances will be as defined in the Hazardous Products Act.
 - .3 Stop work in the area of the suspected hazardous substances.
 - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .5 Hazardous substances will be removed by DCC Representative under a separate contract or as a change to the Work.
 - .6 Proceed only after written instructions have been received from DCC Representative.

1.8 SALVAGE AND DEBRIS MATERIALS

- .1 Demolished items become Contractor's property and will be removed from Project site.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials.

Part 2 Products

2.1 MATERIALS

- .1 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction
- .2 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; DCC Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify DCC Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify DCC Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition and Removal:
 - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active or energized utilities without approval of DCC Representative.
 - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
 - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
 - .5 At end of each day's work, leave worksite in safe condition.
 - .6 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700-09, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701-12, Standard for Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702-10, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA)
 - .1 CSA-B64 Series-23, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08, Commercial and Residential Drains and Cleanouts.
 - .3 CAN/CSA-B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .6 Plumbing and Drainage Institute (PDI)
 - .1 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with contractor's representative and DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written 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:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit one (1) electronic copy of WHMIS SDS in accordance with Section 01 35 43 - Environmental Protection.
- .3 Shop Drawings:
 - .1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.
- .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.

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 plumbing specialties and accessories for incorporation into manual.
 - .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 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 plumbing materials 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 in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79
- .2 Type 1: general duty; cast iron body round, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.
- .3 Type 3: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

2.2 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.
 - .3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
 - .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.3 WATER HAMMER ARRESTORS

- .1 Copper construction, piston type: to PDI-WH201.

2.4 BACK FLOW PREVENTERS

- .1 To CSA-B64 Series.
- .2 The Reduced Pressure Zone Assembly shall consist of two independent torsion spring check modules, a differential pressure relief valve located between and below the two modules, two drip tight shutoff valves, and required torsion spring check modules and relief valve shall be contained with a sleeve accessible single housing constructed from 304 (Schedule 40) stainless steel pipe

with groove end connections. Torsion spring checks shall have replaceable elastomer discs and in operation produce drip tight closure against the reverse flow of liquid caused by backpressure or back siphonage.

2.5 VACUUM BREAKERS

- .1 To CSA-B64 Series.
- .2 Atmospheric vacuum breaker.
- .3 Hose connection vacuum breaker.
 - .1 NPS ¾ female hose thread inlet, NPS ¾ male hose thread outlet, brass finish.

2.6 PRESSURE REGULATORS

- .1 Capacity:
 - .1 Inlet pressure: 1034 kPa.
 - .2 Outlet pressure: 413 kPa.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B 62
- .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A 126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.7 WATER METER

- .1 Water meter shall be supplied by the City of Kingston.

2.8 TRAP SEAL PRIMERS

- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.9 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

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 plumbing specialties and accessories installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative 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 DCC Representative.

3.2 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.

3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada (NPC), provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, at locations required by code, and as indicated.
- .2 Bring cleanouts to wall or finished floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures as required.

3.6 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated on plans and elsewhere as required by code
- .2 Pipe discharge to terminate over nearest drain.

3.7 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated on plans.
- .2 Install on cold water supply to nearest frequently used plumbing fixture.
- .3 Install soft copper tubing to floor drains.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.9 WATER METER

- .1 Install water meter as indicated on plans.

3.10 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning 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.
- .3 Provide continuous supervision during start-up.

3.11 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .4 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.
- .5 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, removability of strainer.
 - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers:
 - .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 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .11 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .12 Water meter:
 - .1 Verify location and accessibility.
 - .2 Test meter reading accuracy.

3.12 CLOSEOUT ACTIVITIES

- .1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning Requirements: reports, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.

3.13 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
 - .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 & Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 Waste Management and Disposal.

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.14 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Thermal insulation for plumbing piping and piping accessories.

1.2 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping.
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 22 05 00 - Common Work Results for Plumbing.

1.3 DEFINITIONS

- .1 For the purposes of this Section:
 - .1 Concealed means insulated mechanical services in suspended ceilings, or in non-accessible chases, or in furred-in spaces.
 - .2 Exposed means not concealed.
 - .3 Jacketing is synonymous with insulation cladding and lagging.
 - .4 Mineral fibre is synonymous with glass fibre, rock wool, or slag wool.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM):
 - .1 ASTM C 335/C 335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 411-19, Standard Specification for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C 449/C 449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C 533-17, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C 547-22a, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .7 ASTM C 1136-21, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- .3 Green Seal Environmental Standards (GS):

- .1 GS-36-13, Adhesives for Commercial Use.
- .4 Midwest Insulation Contractors Association (MICA):
 - .1 North American Commercial and Industrial Insulation Standards (NACIIS) Manual, 9th edition.
- .5 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .6 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.

1.5 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 datasheets. Include product characteristics, performance criteria, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Shop Drawings:
 - .1 Submit drawings with a list of insulation for each service location, insulation type, thickness, and jacketing type.
- .4 Samples:
 - .1 When requested, submit for review a complete assembly of each type of insulation system, coating, and adhesive. Mount sample on a 12-mm plywood board. Affix label beneath each sample indicating service.
- .5 Certificates: When requested, submit manufacturer's certificates certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions: Submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Protect insulation, canvas, and other moisture-sensitive materials from moisture.

Part 2 Products

2.1 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Combustible piping materials, including adhesives in accordance with CAN/ULC-S102:
 - .1 Flame-spread rating: Maximum 25.
 - .2 Smoke developed classification: Maximum 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335/C 335M.
- .2 Type A-1: Rigid moulded mineral fibre without factory-applied vapour retarder jacketing.
 - .1 Mineral fibre: To CAN/ULC-S702.1, ASTM C 547.
 - .2 Maximum "k" factor: To CAN/ULC-S702.1.
- .3 Type C-2: Mineral fibre blanket faced with factory-applied vapour retarder jacketing.
 - .1 Mineral fibre: To CAN/ULC-S702.1, ASTM C 533.
 - .2 Jacketing: To ASTM C 1136.
 - .3 Maximum "k" factor: To CAN/ULC-S702.1, ASTM C 547.

2.3 JACKETING

- .1 Polyvinyl Chloride (PVC) Jacketing:
 - .1 One-piece moulded type and sheet, in accordance with ASTM C 921, with pre-formed shapes as required.
 - .2 Colours: To match adjacent finish paint as selected by DCC Representative from manufacturer's standard colour range.
 - .3 Minimum service temperature: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: Maximum 0.02 perm.
 - .6 Thickness: 0.55 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape in matching colour.
 - .8 Special requirements:
 - .1 Indoor: Flame spread rating 25, smoke developed rating 50.
 - .9 Covering adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Weatherproof Sealant for Jackets Installed Outdoors: In accordance with Section 07 92 00 - Joint Sealants.
- .2 Tape: Self-adhesive, aluminum, reinforced, minimum 50 mm wide.
- .3 Contact Adhesive: Quick setting type.
- .4 Canvas Adhesive: Washable.
- .5 Tie Wire: Stainless steel, minimum 1.5-mm diameter.
- .6 Bands: Stainless steel, 19 mm wide, minimum 0.5 mm thick.
- .7 Thermal Insulating and Finishing Cement: To ASTM C 449, hydraulic setting or air drying type, on mineral wool.
- .8 Vapour Retarder Lap Adhesive: Water-based and fire retardant type, compatible with insulation.
- .9 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .10 Outdoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

Part 3 Execution

3.1 PREPARATION

- .1 Verify that pressure testing of piping systems and adjacent equipment is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install to manufacturer's instructions and in accordance with MICA, NACIIS Manual and TIAC National Standards.
- .2 Provide two (2) layers of insulation with staggered joints when required nominal wall thickness exceeds 75 mm.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .4 Install piping insulation continuous through wall and ceiling openings and sleeves, except where firestopping is required. Coordinate with Section 07 84 00 - Firestopping.
- .5 Supports and Hangers:

- .1 Hangers and supports in accordance with Section 22 05 00 - Common Work Results for Plumbing.
- .2 Install hangers and supports outside vapour retarder jacket.
- .3 Apply high compressive strength insulation that is suitable for piping service at oversized saddles and shoes where insulation saddles have not been provided.

3.3 INSTALLATION - REMOVABLE PRE-FABRICATED INSULATION AND ENCLOSURES

- .1 At expansion joints, valves, flanges and unions at equipment.
 - .1 Install components to permit movement of expansion joint, to permit periodic removal and replacement without damage to adjacent insulation.
 - .2 Install insulation, fastenings, and finishes that are compatible with piping system.
 - .3 Install PVC insulation jacketing.

3.4 INSTALLATION - ELASTOMERIC INSULATION

- .1 Insulation to remain dry.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULE

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings, unless otherwise specified.
- .2 Insulate vent piping 3.0 m from roof penetrations.
- .3 Type: A-1.
 - .1 Securements: Stainless steel wire at 300 mm on centre.
 - .2 Seals: Lap seal adhesive, lagging adhesive.
- .4 Type: C-2.
 - .1 With vapour retarder jacketing.
 - .2 Securements: Stainless steel wire at 300 mm on centre.
 - .3 Seals: Lap seal adhesive, lagging adhesive.
- .5 Provide insulation thickness as listed in the following table.

Applications	TIAC Code	Pipe sizes (NPS) and insulation thickness (mm)			
		Run Out	to 1	1 ¼ to 2	2 ½ to 4
Domestic	A-1	25	25	25	38
HWS					
HW					

Recirculation	A-1	25	25	25	25
Domestic					
CWS	C-2	25	25	25	25
Condensate					
Drain	C-2	25	25	25	25

.6 Finishes:

- .1 Exposed indoors: PVC jacketing.
- .2 Exposed in mechanical rooms: PVC jacketing.
- .3 Concealed, indoors: Canvas on valves, fittings. No additional finish.
- .4 Finish attachments: Stainless steel screws or bands, at 150 mm on centre.
- .5 Seals: Wing or closed.

3.6 SITE QUALITY CONTROL

- .1 Non-Conforming Work: Replace insulation where there is damage to the vapour barrier and insulation is saturated with moisture.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies the Contractor's responsibilities related to commissioning of plumbing systems and their contribution to the overall commissioning work specified in the relevant Sections of Division 01.
- .2 Construction Team: Contractor is responsible for performing tests and verification activities specified in the relevant Sections of Division 22, and submitting reports to Commissioning Authority.
 - .1 Subcontractors: plumbing subcontractors and third-party inspection/testing agencies participate in commissioning activities in coordination with site quality control requirements for Work they are providing.
 - .2 Manufacturers: manufacturers assist verification activities and report on installation, performance and operation of the products/systems they supplied, as specified in the relevant Sections of Division 22.
 - .3 Contractor coordinates the work of subcontractors, inspection/testing agencies and manufacturers with the commissioning requirements of this Section.
- .3 Commissioning Authority (CxA): the CxA may assign a commissioning specialist with expertise in building mechanical systems and controls, to undertake its commissioning responsibilities related to this Section.
- .4 DCC Representative will designate a person to represent the interests of the facility related to work specified in the relevant Sections of Division 22.
 - .1 O&M Representative: DCC Representative may designate an additional representative to participate in the commissioning process and facilitate the transfer of plumbing systems to the facility's O&M staff.
- .5 The requirements of this Section do not replace testing requirements specified in the relevant Sections of Division 22 or reporting activities to demonstrate compliance with building code requirements to the authorities having jurisdiction.

1.2 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.3 ACRONYMS

- .1 BMM - Building Management Manual
- .2 CT - Construction Team
- .3 Cx - Commissioning
- .4 CxA - Commissioning Authority

- .5 EMCS - Energy Monitoring and Control Systems
- .6 FPT - Functional Performance Testing
- .7 O&M - Operation and Maintenance
- .8 TAB - Testing, Adjusting and Balancing

1.4 DEFINITIONS

- .1 Construction Team: the term Construction Team is used in this Section to designate inclusively the Contractor, subcontractors, manufacturers/suppliers and other support disciplines that are responsible for construction/installation of the Work specified in these specifications.
- .2 Cx Forms: forms used to document the inspections, tests and verification activities performed during the commissioning process, as specified in Section 01 91 13 - General Commissioning Requirements.
- .3 Cx Plan: a document developed under the responsibility of the CxA to specify the project's commissioning requirements, as specified in Section 01 91 13 - General Commissioning Requirements.
- .4 Cx Team: the commissioning team consists of project members that participate in the development, refinement and execution of the Cx Plan, as specified in Section 01 91 13 - General Commissioning Requirements.

1.5 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA Z320-11, (R2021), Building Commissioning.
 - .2 CSA Z5000-18, Building Commissioning for Energy Using Systems.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Construction Team - Cx Representative: Contractor to designate a person from the Construction Team to review and coordinate commissioning activities specified in this Section.
 - .1 Representative to be acceptable to CxA with the following qualifications:
 - .1 Technical personnel testing and commissioning of plumbing systems.
 - .2 Site supervisor or project manager within the Construction Team, with direct responsibilities for supervising the execution of work specified in the relevant Sections Division 22.
- .2 Coordination: coordinate the responsibilities of the Construction Team in the Cx process with the responsibilities of other participants that form part of the Cx Team.
 - .1 Coordinate the participation of plumbing subcontractors, inspection/testing agencies and manufacturers in reviewing the Cx Plan, submittals and in assisting testing and demonstration activities related to their work.

- .2 Coordinate commissioning activities with execution of the work during the course of construction to allow Cx participants and the authority having jurisdiction to fulfill their responsibilities for witnessing tests and reviewing installation before concealment of work.
- .3 Review interfaces with other work to ensure submittals and installation requirements are coordinated with other trades, including:
 - .1 Drainage requirements of fire suppression systems and water service entry requirements as specified in the relevant Sections of Divisions 21 and 22.
 - .2 Drainage requirements of HVAC equipment as specified in the relevant Sections of Division 23.
 - .3 Metering equipment and control devices supplied as specified in the relevant Sections of Division 25, but requiring to be installed on plumbing systems.
 - .4 Electrical distribution serving plumbing equipment, including disconnects and starters, as specified in the relevant Sections of Division 26.
- .3 Notification: notify the CxA of activities associated with the commissioning process in accordance with Section 01 91 13 - General Commissioning Requirements.
- .4 Commissioning Conferences: arrange commissioning meetings attended by DCC Representative, CxA, Contractor and plumbing subcontractors in accordance with Section 01 91 13 - General Commissioning Requirements and as follows:
 - .1 Before starting work: to review mock-up requirements and factory testing of systems, components and/or equipment.
 - .2 Coordination of integrated systems: to review and coordinate interfaces of plumbing equipment and control devices to ensure they connect with systems as specified in the relevant Sections of Division 25.
 - .3 During execution of work but before start of commissioning activities: to refine the Cx Plan, commissioning documentation and commissioning schedule.
- .5 Sequencing: perform commissioning activities in general accordance with the commissioning process described in CSA Z320 and CSA Z5000, maintaining the systematic approach to completing and obtaining acceptance for each phase of commissioning in particular with regards to static verification, start-up and functional performance testing.
 - .1 Functional Performance Testing (FPT): perform operational and performance testing by phases starting with individual components and equipment, testing of sub-systems and then proceeding to FPT of overall systems.
 - .2 Integrated Systems: only perform commissioning of integrated systems once the FPT for each individual system forming part of the integrated system has been completed.
 - .3 Demonstration and training activities may form part of certain commissioning activities, as agreed by CxA.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Plumbing Cx Schedule:

- .1 Submit proposed schedule before start of commissioning conferences indicating key activities critical to the commissioning process including:
 - .1 Inspection of plumbing systems.
 - .2 Testing, flushing and cleaning of plumbing piping.
 - .3 TAB activities in coordination with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .4 Commissioning phases: static verification, start-up, functional performance testing, systems orientation, O&M manuals submissions, training sessions.
 - .5 Integrated Testing activities.
 - .6 Review activities to be completed by other participants: DCC Representative, CxA and the authority having jurisdiction.
- .2 Review the proposed schedule through the course of the work and notify the CxA of modifications required.
- .3 Commissioning Forms: Contractor to review and complete forms for documenting static verification and start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.
 - .1 Approved Cx Forms: CxA reviews and approves the final format to use through the commissioning process.
 - .1 Review the forms proposed by CxA and submit comments with proposed adjustments.
 - .2 Contractor may submit its own preferred format for review by the CxA. This may include manufacturer provided checklists.
 - .2 Submit completed static verification and start-up checklists within 48 hours of completion of verification of equipment or system.
- .4 Testing Equipment: submit a list of proposed testing equipment for performing plumbing Cx activities and related tests in accordance with Section 01 91 13 - General Commissioning Requirements.
- .5 Site Quality Control Submittals: submit manufacturers written certificates and reports demonstrating compliance of Work, as specified in the relevant Sections of Division 22.
- .6 Training Program: submit proposed training program and materials in accordance with Section 01 79 00 - Demonstration and Training for Building Commissioning and Section 01 91 13 - General Commissioning Requirements.

1.8 CLOSEOUT SUBMITTALS

- .1 Submit O&M data and as-built information in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Site Modifications: record changes to installations, system configuration and/or controls that were made during the commissioning process to meet the required performance of plumbing equipment and systems.

Part 2 Products

2.1 EQUIPMENT

- .1 Furnish special tools or equipment required for:
 - .1 Verifying or adjusting equipment/system components.
 - .2 Accessing equipment, enclosures or control cabinets.
 - .3 Interfacing with equipment controls or integrated system diagnostics.
- .2 Furnish instruments and equipment required to perform testing and validate performance of plumbing systems through the commissioning process or as specified in the relevant Sections of Division 22.

Part 3 Execution

3.1 STATIC VERIFICATION

- .1 Perform static verification of components, equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Verify installation and connection of equipment, sub-systems and systems.
 - .2 Confirm proper location of valves, sensors, and control components in accordance with design and O&M requirements.
 - .3 Confirm accessibility to plumbing equipment, components, devices and cleanouts for inspection and O&M activities.
 - .4 Confirm that exposed aesthetic components, such as chromed plated piping and escutcheons, are installed in compliance with specifications.
 - .5 Conduct hydrostatic pressure testing of plumbing piping and report results.
 - .6 Record equipment and systems information including: manufacturer, model number, serial number and rated capacities.
 - .7 Confirm completion of labelling and identification of piping, valves, equipment, and control components.
 - .8 Confirm that dielectric couplings have been provided for connections between dissimilar metals.
 - .9 Confirm completion and documentation of equipment prestart-up tests, including manufacturer's factory tests.
 - .10 Confirm that floor drain placement and sloping of finished floors comply with design requirements and adequately capture water from potential floods in the space.
 - .11 Confirm that thermal insulation of plumbing systems and equipment is completed in accordance with design requirements.
 - .12 Confirm that drain caps and drain covers are installed.
 - .13 Conduct video inspection of sanitary piping, and of connection to city infrastructure.
 - .14 Confirm seismic and vibration controls for plumbing equipment/systems are installed in accordance with design details and manufacturer's recommendations.

- .2 Site Quality Control: CxA to conduct random verification on-site to validate the accuracy of static verification reporting. Contractor to assist the CxA on site to review selected samples representing up to 50 % of the overall installation.

3.2 START-UP

- .1 Perform start-up of equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Flushing and cleaning of plumbing piping.
 - .2 Contractor/manufacturer start-up of equipment.
 - .3 Electrical start-up including site electrical tests and verification of overloads and motor rotation.
 - .4 Visual and mechanical inspections following equipment start-up.
 - .5 Domestic water sanitization and water sample testing.
 - .6 Verify operation of safety controls and interlocks.
 - .7 Complete inspections required by authorities having jurisdiction (AHJ).
 - .8 Measure temperature performance for plumbing systems.
 - .9 Setup and adjustment of pressure-reducing valves (PRVs).
 - .10 Adjustment of thermostatic mixing valves to provide design supply temperatures.
- .2 Site Quality Control: CxA will witness start-up activities for selected equipment. Notify the CxA of start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- .1 Perform Functional Performance Testing (FPT) on plumbing equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and as directed by the CxA.
- .2 Operate equipment as directed by CxA to demonstrate and validate that equipment, sub-systems and systems function and perform in accordance with design requirements.
- .3 FPT activities to include the following:
 - .1 Verify proper operation of plumbing systems and equipment in the following modes of operation:
 - .1 Systems operation on normal power.
 - .2 Systems operation on emergency power.
 - .3 Normal operation - no alarm conditions.
 - .4 Systems operation in alarm condition.
 - .5 Manual operation mode.
 - .6 Automatic operation mode.
 - .2 Verify operation of safety cutouts, alarms and interlocks.

- .3 Verify time required for hot water delivery to plumbing fixtures.
- .4 Verify that plumbing fixture flowrates comply with design requirements.
- .5 Verify operation of electronic controls on automated fixtures, with an emphasis on minimizing water usage.
- .6 Verify operation of compressed air systems and equipment and optimize controls.
- .7 Confirm that temperature of domestic hot water storage equipment comply with design requirements.
- .8 Verify that the proper schedules were configured for plumbing equipment and confirm that systems are disabled when not required.
- .9 Verify TAB results in coordination with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Verify data integration of metering equipment to the facility's EMCS.
- .11 Verify data transfer between plumbing equipment integrated controls and the building's EMCS.
- .12 Verify and adjust system response to:
 - .1 Power failure.
 - .2 Loss of natural gas service.
 - .3 Loss of domestic water supply.

3.4 CX OF INTEGRATED SYSTEMS

- .1 Operate equipment as directed by CxA to perform commissioning of integrated systems.

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: obtain written certificates and reports from manufacturer verifying compliance of Work and submit Manufacturer's Site Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Provide manufacturer's site services to complete start-up activities and assist in Functional Performance Testing as specified in the relevant Sections of Division 22.

3.6 CLOSEOUT ACTIVITIES

- .1 Corrections: Provide equipment, materials and labor as required to correct installation and/or equipment deficiencies identified through the commissioning process.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 11 16 - Domestic Water Piping.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with contractor's representative and DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written 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, specifications and data sheet for fixtures and equipment.
 - .2 Submit WHMIS SDS. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings: Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or site 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' Site Reports: manufacturers' site reports specified.

1.5 CLOSEOUT SUBMITTALS

- .1 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMP

- .1 Capacity: see the pump schedule on the plan.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 860 kPa and 105 degrees C continuous service.
- .3 Motor: drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.

Part 3 Execution

3.1 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

3.2 SITE 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.

3.3 START-UP

- .1 Refer to Section 01 91 13 - General Commissioning Requirements for commissioning requirements.
- .2 General: In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
 - .1 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.

3.4 DOMESTIC HW CIRCULATING PUMPS

- .1 Balance flow using the circuit balancing valve.

3.5 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: reports, supplemented as specified. 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.

3.6 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M personnel, supplemented as specified.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Section 23 05 23.01 - Valves – Bronze.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Section 33 11 16 - Site Water Utility Distribution Piping.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME):
 - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9-14, Building Services Piping.
- .2 ASTM International (ASTM):
 - .1 ASTM A 182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
 - .2 ASTM A 269-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A 312/A 312M-16, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 ASTM A 351/A 351M-16, Castings, Austenitic, for Pressure Containing Parts.
 - .6 ASTM A 403/A 403M-16, Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 ASTM A 536-84(2014), Standard Specification for Ductile Iron Castings.
 - .8 ASTM B 32-08(2014), Standard Specification for Solder Metal.
 - .9 ASTM B 42-15a, Seamless Copper Tube, Standard Sizes.
 - .10 ASTM B 88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA):
 - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

- .2 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water.
- .4 CSA Group (CSA):
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings
- .5 Department of Justice Canada (Jus):
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS)
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
 - .1 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC):
 - .1 National Plumbing Code of Canada (NPC) 2025.
- .9 Transport Canada (TC):
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).
- .10 ULC Standards (ULC):
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials
 - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide manufacturer's product literature and datasheets for insulation and adhesives. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L: to ASTM B 88M.
 - .2 Buried or embedded:
 - .1 Copper tube, soft annealed, type L: to ASTM B 88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: 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:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242
- .6 NPS 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22 or cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

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, lead free.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GLOBE VALVES

- .1 NPS2 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 23.01 - Valves - Bronze.
- .2 Lockshield handles: as indicated.
- .2 NPS 2 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 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.

2.5 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 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 23.01 - Valves - Bronze.

2.6 BALL VALVES

- .1 As specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with NPC, Province Plumbing Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 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.
- .7 Valves:
 - .1 Isolate equipment, fixtures and branches with ball valves.

- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.2 PRESSURE TESTS

- .1 Conform to requirements of Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.3 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours.
- .2 Let stand for 24 hours, then draw one (1) sample off longest run.
- .3 Submit to testing laboratory to verify that system is clean to Provincial and Federal potable water guidelines.
- .4 Let system flush for additional 2 hours, then draw off another sample for testing.

3.4 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.

3.5 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of DCC Representative.
- .2 Coordinate with Section 33 11 16 - Site Water Utility Distribution Piping.
- .3 Upon completion, provide laboratory test reports on water quality for DCC Representative approval.

3.6 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.
- .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 HWS storage tank up to design temperature slowly.
- .4 Monitor HWS and HWC piping systems for freedom of movement, pipe expansion.
- .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.7 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are 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 TAB hot water recirculation 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 HWS and HWC systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with safety and health requirements.
 - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: using report forms as specified in Section 01 91 13 - General Commissioning Requirements.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.8 OPERATION REQUIREMENTS

- .1 Coordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Operational requirements in accordance with Section 01 78 00 - Closeout Submittals, include:
 - .1 Cleaning materials and schedules.

- .2 Repair and maintenance materials and instructions.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 - Common installation requirements for HVAC pipework.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM B 32-08, Standard Specification for Solder Metal.
 - .2 ASTM B 306-02, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 CSA Group (CSA)
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-05, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

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 and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 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.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

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-antimony 95:5, type TA, to ASTM B 32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating of butimous.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70 or ASTM C 564.
 - .2 Stainless steel clamps.
 - .2 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Cold caulking compounds.
 - .2 Above ground sanitary 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 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.
- .2 Install in accordance with National Plumbing Code, 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 that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (sanitary, vent, etc.) c/w directional arrows 3.0 m.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2 ASTM International (ASTM):
 - .1 ASTM A 47/A 47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278/A 278M-01(2011), Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A 516/A 516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536-84(2009), Standard Specification for Ductile Iron Castings
 - .5 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group (CSA):
 - .1 CSA B51:24, Boiler, Pressure Vessel, and Pressure Piping Code.

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 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.

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 incorporation into manual.
- .3 Submit one (1) electronic copy of operation and maintenance manual.

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, in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
 - .2 Store and protect 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 in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 THERMAL EXPANSION TANK

- .1 The unit shall be constructed per ASME Code Section VIII, Division 1.
- .2 Maximum Operating Conditions:
 - .1 Operating temperature: 93°C (200°F).
 - .2 Working Pressure: 10.5 bar (150 psig).
- .3 Standard Factory Pre-charge 3.9 bar (55 psig).
- .4 System Connection: stainless steel.
- .5 Diaphragm: heavy duty butyl NSF/ANSI 61.
- .6 Liner Material: polypropylene.
- .7 Shell: steel.
- .8 Finish: red oxide primer.

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 installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative 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 DCC Representative.

3.2 APPLICATION

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

3.3 GENERAL

- .1 Maintain adequate clearance to permit service and maintenance.
- .2 Should deviations beyond allowable clearances arise, request and follow DCC Representative's directive.
- .3 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 THERMAL EXPANSION TANK

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Install lockshield type valve at inlet to tank.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .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 REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA B51:19, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CSA C22.2 No.110-19, Construction and Test of Electric Storage Tank Water Heaters.
 - .3 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Domestic Hot Water Service.
- .2 National Research Council Canada (NRC):
 - .1 National Plumbing Code of Canada 2020 (NPC).

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 and datasheets for domestic water heater, 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:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and site assembled.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

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.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 35 43 - Environmental Protection and Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

1.6 WARRANTY

- .1 For the Work of this Section 22 33 00 - Electric Domestic Water Heater, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.

Part 2 Products

2.1 ELECTRIC WATER HEATER

- .1 The water heater shall meet the standby loss requirements of current edition of ASHRAE/IES 90.1.
- .2 The water heater shall have 1,034kPa working pressure and be equipped with extruded high density anode rod.
- .3 All internal surfaces of the water heater exposed to water shall be glass lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 760°C to 870°C.
- .4 Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.
- .5 The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation.
- .6 Electrical junction box with heavy duty terminal block shall be provided.
- .7 The drain valve shall be located in the front for ease of servicing.
- .8 Heater tank shall have a three-year limited warranty as outlined in the written warranty.
- .9 Fully illustrated instruction manual shall be included.

2.2 TRIM AND INSTRUMENTATION

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
- .3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.
- .4 Thermowell filled with conductive paste for control valve temperature sensor.
- .5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

2.3 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation in concrete support pad in accordance with Section 03 30 00 - Cast-in-Place Concrete.

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 manufacturer's recommendations and authority having jurisdiction.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heater.
- .2 Refer to Section 01 91 13 - General Commissioning (Cx) Requirements for commissioning requirements.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 35 43 - Environmental Protection and Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
 - .2 CSA B125.3-18, Plumbing Fittings.
 - .3 CSA B651-18, Accessible Design for the Built Environment.
- .2 Green Seal (GS):
 - .1 GS-36-2013, Adhesives for Commercial Use.
- .3 National Research Council Canada (NRC):
 - .1 National Building Code of Canada 2020 (NBC).
- .4 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

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 water closet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 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.

1.4 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, in dry location 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CSA B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Refer to Plumbing Fixture Schedule on plans for details.
- .6 Fixture piping:
 - .1 Hot and cold water supplies to fixtures:
 - .1 Chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P-trap with clean out on fixture not having integral trap.
 - .2 Chrome plated in exposed places.

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 washroom fixtures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified in the plumbing fixture schedule on the plan.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixture to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Water closet: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CSA B125.3-18, Plumbing Fittings.
 - .3 CSA B651-18, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).

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 and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide 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.

1.4 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.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series

- .2 Trim, fittings: manufacture in accordance with CSA B125.3
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures to be product of one manufacturer.
- .6 Trim to be product of one manufacturer.
- .7 Refer to Plumbing Fixture Schedule on plans for details.
- .8 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated flexible supply pipes each with screwdriver 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.
- .9 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

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 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated, measured from finished floor.
 - .3 For persons with disabilities: to comply with most stringent of either NBC or CSA B651.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified in the plumbing fixture schedule on the plan.
- .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.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 USE OF SYSTEMS

- .1 Use of new and/or existing permanent heating and/or 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 RELATED REQUIREMENTS

- .1 Section 09 91 99 - Painting.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 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 products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify Section and paragraph number.

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 and incorporate into manual.
 - .1 Operation and maintenance manual approved by, and final copies submitted to DCC Representative before final inspection.
 - .2 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 Colour coding chart.
- .3 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.
- .4 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.
- .5 Approvals:
 - .1 Submit one (1) electronic copy of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted.
 - .2 Make changes as required and re-submit as directed by DCC Representative.
- .6 Additional data:
 - .1 Prepare and insert into Operation and Maintenance Manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .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.
- .8 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 DCC Representative 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Supply spare parts as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Supply one set of special tools required to service equipment as recommended by manufacturers.
- .4 Supply one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packaging Waste Management: Perform in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 All materials used on this project shall be new and CSA approved.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 SITE QUALITY CONTROL

- .1 Site Tests: conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Submit tests as specified in other sections of this specification.
- .2 Manufacturer's Site 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 - ACTION AND INFORMATIONAL 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.

3.3 ADJUSTING

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Perform painting in accordance with Section 09 91 99 - Painting.
- .3 Restore finishes which have been damaged to a "like new" condition.

3.4 CLEANING

- .1 Final Cleaning: Perform in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal and clean interior and exterior of all systems including strainers. Vacuum interior of ductwork, DOAS air handling unit and indoor fan coil units.

3.5 DEMONSTRATION

- .1 DCC Representative 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, troubleshooting 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.
- .5 DCC Representative will record these demonstrations for future reference.

3.6 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Selective demolition and removal of:
 - .1 Heating, ventilation, and air conditioning systems; and
 - .2 Controls and automation components.

1.2 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping.
- .2 Section 22 05 05 - Selective Demolition for Plumbing.

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and dispose of off site.
- .2 Remove: Deconstruct, or disassemble, and detach items from existing construction.
- .3 Hazardous Materials: Products, mixtures, materials, or substances classified as physical hazards or health hazards in accordance with Schedule 2 of the Hazardous Products Act.

1.4 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA Z783:12, Deconstruction of Buildings and Their Related Parts.
- .2 Department of Justice Canada:
 - .1 Hazardous Products Act, 1985.
- .3 Environment and Climate Change Canada (ECCC):
 - .1 Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems 2015.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate work of this Section with:
 - .1 Section 22 05 05 - Selective Demolition for Plumbing.
 - .2 Pre-Demolition Meetings: Conduct a site meeting attended by the DCC Representative and related Subcontractors to:
 - .1 Verify project requirements, including existing construction conditions affected by work of this section, scope of selective demolition work, demolition sequencing, and protection of in-place conditions.

- .2 Review scheduling of utility disruptions that may affect building occupants.
- .3 Coordinate with other Subcontractors.

.2 Scheduling:

- .1 Maintain project schedule without compromising specified minimum material diversion rates.
- .2 Notify the DCC Representative of unforeseen delays in writing.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following when requested by the DCC Representative.
 - .1 Qualification statements: Information about companies and personnel indicating their experience and capabilities to perform demolition work; include lists of completed projects with project names and addresses, and names and addresses of consultants for work of similar complexity and extent.
- .3 Submit copies of the following, when required by the authority having jurisdiction (AHJ):
 - .1 Reviewed shop drawings; and
 - .2 Reviewed demolition procedures.

1.7 SITE 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.
- .2 Hazardous materials are not expected to be encountered in the Work.

Part 2 Products

2.1 MATERIAL OWNERSHIP

- .1 Coordinate material ownership with the DCC Representative.
 - .1 The Owner will retain ownership of:
 - .1 Items to remain;
 - .2 Items to be re-used;
 - .3 Items to be re-installed;
 - .4 Items to be removed and turned over to the DCC Representative; and
 - .5 Other items of interest or value to the Owner that may be encountered during demolition.
 - .2 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.
- .2 HVAC Repair Materials: Use new materials required for completion or repair matching materials damaged during performance of work of this Section. New materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the AHJ.
- .3 Firestopping Repair Materials: Use fire stopping materials compatible with existing firestopping systems in accordance with Section 07 84 00 - Firestopping. Where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Review existing conditions and coordinate with indicated requirements to determine extent of demolition required.
- .2 Review record documents of existing facility available from DCC Representative.
- .3 DCC Representative does not guarantee record documents are accurate, complete, or appropriate.
- .4 Inventory and record the condition of items being removed and turned over to the DCC Representative. Promptly submit a written report to the DCC Representative.
- .5 When unforeseen structural, mechanical, electrical, or other issues are encountered that interfere with demolition or removal, investigate and measure the nature and extent of the interference. Promptly submit a written report to the DCC Representative.
- .6 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 the building or structure, or adjacent buildings or structures, during demolition operations.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Use methods, certified by a qualified licensed professional engineer to prevent movement, settlement, or damage to adjacent properties and buildings, structures, utilities to remain in place. Provide temporary bracing and shoring as required.
 - .2 Minimize noise, dust, vibration, and inconvenience to occupants in accordance with Section 01 14 00 - Work Restrictions. Provide temporary negative air pressure in demolition areas relative to adjacent occupied areas.
 - .3 Protect building systems, utilities, equipment, and other items to remain.
 - .4 Provide temporary dust screens, covers, railings, supports, and other protection in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

- .5 Protect interior items exposed to the weather in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.
- .6 Maintain access to egress, walkways, corridors, exits, and other adjacent occupied or partially occupied facilities, unless approved, in writing, by the AHJ.
 - .1 Submit copy of written approval from the AHJ.

3.3 DEMOLITION AND REMOVAL REQUIREMENTS

- .1 Demolish or remove select HVAC items in accordance with CSA Z783.
- .2 Disconnect and cap gas supply and electrical services in accordance with requirements of the AHJ.
- .3 Disconnect and remove electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel. Do not damage adjacent assemblies designated to remain.
- .4 Do not disrupt active or energized utilities without approval of DCC Representative.
- .5 Use methods to minimize dust, such as wetting dust-producing materials.
- .6 Leave Work in safe and stable condition at end of each Working Day.
- .7 Dispose of demolished items off site. Comply with hauling and disposal regulations of AHJ.

3.4 DEMOLITION

- .1 Demolish items as indicated on drawings.

3.5 REMOVE

- .1 Remove items as indicated on drawings.

3.6 REPAIRS AND RESTORATION

- .1 Promptly repair damage to adjacent construction caused by work of this section. Patch existing surfaces to make suitable for new materials.
- .2 Restore exposed finishes on patched surfaces. Extend restoration to adjoining construction to eliminate evidence of patching and refinishing.

3.7 CLEANING

- .1 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
 - .2 Refrigerant Disposal: Dispose of refrigerants at an approved facility in accordance with the ECCC Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

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END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives, and guards for mechanical equipment and systems.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society (IES):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group (CSA):
 - .1 CSA C390:10, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors
- .3 National Electrical Manufacturers Association (NEMA):
 - .1 ANSI/NEMA MG 1-2021, Motors and Generators.
 - .2 NEMA MG 11-1977, Energy Management Guide for Selection and Use of Single-Phase Motors.

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 literature, specifications, and datasheets, including product characteristics, performance criteria, wiring characteristics, and limitations.
 - .2 Submit a complete list of HVAC motors and identify their locations before beginning installation of motors.
- .3 Shop Drawings: Submit drawings, indicating work of other Subcontractors, and identify areas that might have congestion or conflicts.
- .4 When requested, submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit maintenance data for motors, drives, and guards and incorporate into operation and maintenance manual.
- .3 Submit field test reports.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals, unless otherwise indicated in other Division 23 Sections.

1.6 QUALITY ASSURANCE

- .1 Where multiple motors are required for the same application, provide the same manufacturer's motor model for all identical conditions.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading: Perform in accordance with Section 01 61 00 - Common Product Requirements, and as follows:
 - .1 Protect motors from dust and corrosion.
- .2 Packaging Waste Management and Disposal: Perform Waste Management Plan in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 REGULATORY REQUIREMENTS

- .1 Motors shall be premium efficiency, in accordance with local hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified in other Sections.
- .2 Motors: High efficiency, in accordance with ANSI/ASHRAE/IES 90.1.
- .3 Motors under 373 W (1/2 hp): NEMA MG, speed, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated on drawings.
- .4 Motors 373 W (1/2 hp) and larger: ANSI/NEMA MG 1, CSA C390, squirrel cage induction, speed as indicated, continuous duty, drip-proof, ball bearing, maximum temperature rise 40°C, 3 phase, as indicated on drawings.
- .5 Temporary Motors: Motor with adequate performance approved by DCC Representative for temporary use.

2.3 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

- .3 For motors under 7.5 kW (10 hp): Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified motor rpm.
- .4 For motors 7.5 kW (10 hp) and over: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Determine correct sheave size during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Provide motor slide rail adjustment plates to allow for centre line adjustment.

2.4 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2mm-thick sheet metal tops and bottoms.
 - .3 38mm diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Drive Guards: Designed to allow motor maintenance (lubrication and use of test instruments) with guards in place.
- .4 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6mm-thick galvanized mild steel.
 - .2 Fasten securely in place.
 - .3 Removable for servicing.
- .5 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Fasten securely in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 INSTALLATION

- .1 Install according to manufacturer's instructions and supplemented by the requirements of the Contract Documents.
- .2 Locate motors with adequate access space to allow safe and unimpeded maintenance services.

- .3 Install with minimum interference with other equipment and services.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Fasten motors and equipment securely in place.
- .6 Replace temporary motors with specified motors.

3.2 SITE QUALITY CONTROL

- .1 Field Tests: Conduct the following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 As specified in other sections of this specification.

3.3 CLEANING

- .1 Comply with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 84 00 - Fire Stopping.
- .2 Section 07 92 00 - Sealants.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Green Seal Environmental Standards (GS):
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings
- .3 National Research Council Canada (NRC):
 - .1 National Fire Code of Canada 2020 (NFC).
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI:
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-2017, Adhesive and Sealant Applications.

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 datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Paint: zinc-rich to CAN/CGSB-1.181.

- .1 Primers, Paints, Coating: in accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Sealants.
- .3 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

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 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.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 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.

3.5 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.

3.6 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.

.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 Provide for thermal expansion as required.

3.7 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 25mm 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 fire stopping.
 - .2 Maintain the fire-resistance rating integrity of the fire separation.
 - .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.

3.8 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.

3.9 PREPARATION FOR FIRE STOPPING

- .1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.
- .3 Insulated pipes: ensure integrity of insulation and vapour barriers.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise DCC Representative 48 hours minimum prior to performance of pressure tests.
- .2 PIPework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

- .5 Conduct tests in presence of DCC Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. DCC Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by DCC Representative.

3.11 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by DCC Representative.
- .2 Request written approval by DCC Representative ten (10) working days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.12 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 23 05 17 - Pipe Welding.
- .4 Section 23 08 13 - Performance Verification.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A 53/A 53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 105/A 105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

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 and datasheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 ANCHORS AND GUIDES

- .1 Anchors:
 - .1 Provide as required.
 - .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
 - .3 Reinforcement: to Section 03 20 00 - Concrete Reinforcing.
- .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 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 pipe anchors and guides as required. Anchors to withstand 150% of axial thrust.
- .2 Do welding in accordance with Section 23 05 17 - Pipe Welding.

3.3 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 13 - Performance Verification.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping.
 - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007.
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS):
 - .1 AWS C1.1M/C1.1-2000, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .4 CSA Group (CSA):
 - .1 CSA W47.2-M1987, Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-03, Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-2008, Certification of Welding Inspectors.
- .5 Provincial regulations: Boiler, Pressure Vessel and Compressed Gas Regulations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to DCC Representative.

- .4 Each welder to possess identification symbol issued by authority having jurisdiction.
- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
 - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of welding procedures available for inspection.
 - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

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 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 23, applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.

- .2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with DCC Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in cooperation with DCC Representatives.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by DCC Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and spot or full gamma ray radiographic (hereinafter referred to as "radiography") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by DCC Representative of total of up to 30 % of welds, selected at random by DCC Representative by radiographic tests.
- .5 Full radiographic tests for piping systems.
 - .1 Spot radiography:
 - .1 Conduct spot radiographic tests of up to 30% of welds, selected at random by DCC Representative from welds which would be most difficult to repair in event of failure after system is operational.
 - .2 Radiographic film:
 - .1 Identify each radiographic film with date, location, name of welder, and submit to DCC Representative. Replace film if rejected because of poor quality.
 - .3 Interpretation of radiographic films:
 - .1 By qualified radiographer.
 - .4 Failure of radiographic tests:

- .1 Extend tests to welds by welder responsible when those welds fail tests.
- .6 Magnetic particle tests for piping systems as indicated.

3.6 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code

3.7 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 23.01 – Valves – Bronze.
- .2 Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

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 thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finishes, and limitations.
- .3 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test and Evaluation Reports:
 - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: dual imperial and metric.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125-mm scale length, in accordance with ASME B40.200.
 - .1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

- .1 Copper Pipe: Copper or bronze.
- .2 Steel Pipe: Brass or stainless steel.

2.4 PRESSURE GAUGES

- .1 Dial type: To ASME B40.100, Grade 2A, 112-mm size, phosphor bronze or stainless steel bourdon tube having 0.5% accuracy full scale.
- .2 Provide:
 - .1 Siphon for steam service.
 - .2 Snubber for pulsating operation.
 - .3 Diaphragm assembly for corrosive service.
 - .4 Gasketed pressure relief back with solid front.
 - .5 Bronze valves to Section 23 05 23.01 – Valves – Bronze.
 - .6 Oil filled for high vibration applications, such as pumps.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed are acceptable for installation in accordance with manufacturer's instructions.
 - .1 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install thermometers and gauges so they can be easily read from floor.
- .2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated on drawings and on inlet and outlet of:
 - .1 DHW tanks.

- .3 Install wells.
- .4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

- .1 Install in locations:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of pressure reducing valves.
 - .3 Upstream and downstream of control valves.
 - .4 In other locations as indicated.
- .2 Use extensions through insulation where pressure gauges are installed.

3.5 NAMEPLATES

- .1 Install nameplates in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment, identifying medium.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation of work in this Section.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.18-2018, Cast Copper Alloy Solder-Joint Pressure Fittings.
- .2 ASTM International (ASTM):
 - .1 ASTM A 276-08, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

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 and data sheets for equipment and systems 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 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

1.5 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 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ASME B1.20.
 - .2 Copper tube systems: solder ends, grooved ends to ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

2.2 GATE VALVES

- .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.

- .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
- .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: handwheel.
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
 - .3 Operator: handwheel.
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.

2.3 GLOBE VALVES

- .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
- .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
 - .3 Operator: handwheel.
- .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.

- .3 Operator: handwheel.
- .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A 276, loosely secured to stem
 - .3 Operator: handwheel.
- .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: handwheel.

2.4 CHECK VALVES

- .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
- .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .3 NPS 2 and under, swing type, bronze disc, Class 150:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .4 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
- .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable no. 6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B 62.
- .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

2.5 SILENT CHECK VALVES

- .1 NPS 2 and under:

- .1 Body: cast high tensile bronze to ASTM B 62 with integral seat.
- .2 Pressure rating: Class 125.
- .3 Connections: screwed ends to ASME B1.20 and with hex. shoulders.
- .4 Disc and seat: renewable rotating disc.
- .5 SPEC NOTE: Spring required in vertical downflow applications.
- .6 Stainless steel spring, heavy duty.
- .7 Seat: regrindable.

2.6 BALL VALVES

- .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class 125, 860 kPa steam.
 - .3 Connections: screwed ends to ASME B1.20 and with hexagonal shoulders.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel or hard chrome solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.

Part 3 Execution

3.1 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.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 23.01 - Valves – Bronze.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International (ASTM):
 - .1 ASTM A 49-01, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A 126-04, Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A 536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B 85/B 85M-08, Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B 209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - .1 MSS SP-61-03, Pressure Testing of Steel Valves.
 - .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82-1992, Valve Pressure Testing Methods.
 - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

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 datasheets for valves 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.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

Part 2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B 209 Class B.
 - .2 Connections: flanged ends plain face to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

- .7 Gland packing: non-asbestos.
- .8 Handwheel: die-cast aluminum alloy to ASTM B 85/B 85M or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62.
 - .3 Seat rings: renewable bronze to ASTM B 62, screwed into body.
 - .4 Stem: bronze to ASTM B 62.
 - .5 Operator: handwheel.
- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: manganese-bronze.
 - .5 Pressure-lubricated operating mechanism.
 - .6 Operator: handwheel.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service
 - .2 UL and FM Label: on valve yoke
 - .3 Body, Bonnet: cast iron to ASTM A 126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.

- .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
- .12 Operator: handwheel.

2.4 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
 - .1 Body: with multiple-bolted bonnet.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP.
 - .3 Bonnet-yoke gasket: non-asbestos.
 - .4 Disc: bronze to ASTM B 62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B 62.
 - .7 Operator: handwheel.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves: spindle uprights or parallel position.
- .3 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
- .4 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.
 - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.6 VALVE OPERATORS

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.

2.7 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A 126 Class B.
 - .2 Ratings:

- .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
- .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62.
- .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
- .5 Hinge pin, bushings: renewable bronze to ASTM B 62.
- .6 Identification tag: fastened to cover.
- .7 Hinge: galvanized malleable iron.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
 - .1 Body and bolted cover: cast iron to ASTM A 126 Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 250 psi steam; 500 psi CWP.
 - .4 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B 61.
 - .2 NPS 4 - 8: iron faced with ASTM B 61 bronze.
 - .5 Seat rings: renewable bronze to ASTM B 61, screwed into body.
 - .6 Hinge pin, bushings: renewable, bronze to ASTM B 61.
 - .7 Hinge: galvanized malleable iron.
 - .8 Identification tag: fastened to cover.

2.8 SILENT CHECK VALVES

- .1 Construction:
 - .1 Body: malleable or ductile iron with integral seat.
 - .2 Pressure rating: Class 125, WP = 860 kPa.
 - .3 Connections: grooved ends.
 - .4 Disc: bronze or stainless steel renewable rotating disc.
 - .5 Seat: renewable, EPDM.
 - .6 Stainless steel spring, heavy duty.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):
 - .1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1-05, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API):
 - .1 API Std. 609-04, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International (ASTM):
 - .1 ASTM A 126-04, Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A 536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - .1 MSS SP-67-02a, Butterfly Valves.

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 printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit data for valves specified in this Section.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

Part 2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

- .1 Except to specialty valves, to be of single manufacturer.
- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
 - .1 Wafer or lug type: NPS 2 to 30.
 - .2 Grooved end type: NPS 2 to 12.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 - 12: 200 psig.
- .6 Minimum seat temperature ratings to 135°C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded) or grooved ends.

- .9 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body ductile iron.
 - .2 Disc: aluminum bronze.
 - .3 Seat: EPDM.
 - .4 Shaft: 416 stainless steel.
 - .5 Taper pin: 316 SS.
 - .6 Key: carbon steel.
 - .7 O-Ring: Buna-N.
 - .8 Bushings: luberized bronze Teflon.

2.2 BUTTERFLY VALVES - RESILIENT SEAT - 285 PSIG

- .1 Sizes:
 - .1 Lug type: NPS 2 to 48.
 - .2 Grooved end type: NPS 2 to 12.
- .2 Pressure rating: 285 psig at 135°C.
- .3 Lug body: 150 ANSI bolt pattern.
- .4 Full lug body (threaded) or grooved ends.
- .5 Application: for on-off service.
- .6 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
 - .2 Install parallel or perpendicular to pipeline.
- .7 Designed to comply with MSS SP-67 and API 609.
- .8 Compatible with ASME B16.1 Class 125 (iron) and ANSI/ASME B16.5 Class 150 (steel) flanges.
- .9 Construction:

- .1 Body: ductile iron.
- .2 Disc: aluminum bronze.
- .3 Seat: EPDM.
- .4 Refer to manufacturer's literature for additional materials.
- .5 Shaft: NPS 2 - 12: 416 stainless steel.
- .6 Taper pin: 316 SS.
- .7 Blowout proof stem.
- .8 O-Ring: Buna-N.
- .9 Bushings: Teflon.
- .10 Disc shall not be pinned to shaft.
- .11 Bubble tight shutoff with downstream flanges removed, class 6 shutoff.

2.3 MOUNTING FLANGES

- .1 Class 125 cast iron to ASME B16.1 or Class 150 steel to ANSI/ASME B16.5.

Part 3 Execution

3.1 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Handle valve with care so as to prevent damage to disc and seat faces.
- .5 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .6 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 ACTUATOR INSTALLATION

- .1 Cycle valve operation from fully closed to fully open then back to fully closed.
- .2 At same time, check travel stop settings for proper disc alignment.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM):
 - .1 ASTM A 125-1996, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 National Research Council Canada (NRC):
 - .1 National Plumbing Code of Canada 2020 (NPC).

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 and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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 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 ASME B31.1 or MSS SP 58
 - .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

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ANSI B31.1.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 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 NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.

- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved to MSS-SP 58 and MSS-SP 69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.
- .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, FM approved to MSS SP 69.
- .5 Shop and site-fabricated assemblies:
 - .1 Trapeze hanger assemblies: MSS SP-89.
 - .2 Steel brackets: MSS SP-89.
 - .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 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.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69, UL listed, FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP 58, type 42, UL listed, FM approved.
- .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.

2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .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:
 - .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.

2.6 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 site adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13mm minimum, 50mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50mm: 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. Provide certificate of calibration for each hanger.

- .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

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:
 - .1 Manufacturer's instructions and 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 Plumbing piping: to National Plumbing Code of Canada (NPC), Provincial Code, authority having jurisdiction.
- .2 Gas piping: up to NPS 1/2: every 1.8m.
- .3 Copper piping: up to NPS 1/2: every 1.5m.

- .4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

- .5 Within 300 mm of each elbow.

<u>Maximum Pipe Size: NPS</u>	<u>Maximum Spacing Steel</u>	<u>Maximum Spacing Copper</u>
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 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.

3.7 SITE QUALITY CONTROL

- .1 Manufacturer's Site 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 - ACTION AND INFORMATIONAL 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.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.
- .2 Related Requirements
 - .1 Section 07 84 00 - Fire Stopping.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .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.
 - .1 Submit one (1) electronic copy of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 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 Province of Ontario, Canada.
 - .2 Provide separate shop drawings for each isolated system, system shop drawings complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 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 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

- .1 Do construction in accordance with occupational health and safety.

1.5 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.

.2 Waste Management and Disposal:

- .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation.

2.2 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor, 100% relative humidity installations.
- .4 Colour code springs.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.4 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 Seismic control systems to work in every direction.
 - .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .3 Drilled or power driven anchors and fasteners not permitted.
 - .4 No equipment, equipment supports or mounts to fail before failure of structure.
 - .5 Supports of cast iron or threaded pipe not permitted.
 - .6 Seismic control measures not to interfere with integrity of fire stopping. Coordinate with Section 07 84 00 - Fire Stopping.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
 - .1 Piping systems: hangers longer than 305 mm; brace at each hanger.
 - .2 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
 - .1 Approved by DCC Representative.
 - .2 Structural angles or channels.

- .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

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 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring hangers with 25mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to DCC Representative within 3 days of manufacturer representative's review.

- .4 Make adjustments and corrections in accordance with written report.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .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

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, ductwork and controllers, including the installation and location of identification systems.

1.2 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA):
 - .1 CSA/CGA B149.1-20, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Include paint colour chips, other products specified in this Section.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures
- .2 Health and Safety:
 - .1 Do construction in accordance with occupational health and safety.

1.5 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.
- .2 Waste Management and Disposal:

- .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Dispose of unused paint, coating material at official hazardous material collections site approved by DCC Representative.
- .3 Do not dispose of unused paint, coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:

- .1 Conform to following table:

<u>Size # mm</u>	<u>Sizes (mm)</u>	<u>No. of Lines</u>	<u>Height of Letters (mm)</u>
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

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:

- .1 Terminal cabinets, control panels: use size # 5.
- .2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this Section.
- .3 Before starting work, obtain written approval of identification system from DCC Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1, authority having jurisdiction.

2.5 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 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 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.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from DCC Representative.

.2 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

<u>Contents</u>	<u>Background colour marking</u>	<u>Legend</u>
** Add design temperature		
++ Add design temperature and pressure		
Domestic cold water supply	Green	DOM. CWS
Domestic hot water supply	Green	DOM. HWS
Domestic HW recirculation	Green	DOM. HW CIRC
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Compressed air	Green	COMP. AIR
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or coordinated with base colour to ensure strong contrast.

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 in Section 09 91 99 - 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: at not more than 17 m 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 ceiling 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 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 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

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END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Testing, adjusting, and balancing of HVAC equipment to achieve specified performance requirements.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE Standard 111-2008, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- .2 Associated Air Balance Council (AABC):
 - .1 ANSI/AABC National Standards for Total System Balance, Seventh Edition, 2016.
- .3 National Environmental Balancing Bureau (NEBB):
 - .1 NEBB Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems, Ninth Edition, 2019.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA 1780-2002 - HVAC Systems - Testing, Adjusting and Balancing.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Test and balance each system independently and where interlocked with other systems, in unison with those systems.
- .2 Scheduling:
 - .1 Schedule time required for work of this section (including repairs, and re-testing) into Project schedules to ensure completion before scheduled completion date.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit proposed methodology and procedures for performing work of this section.
- .2 Before starting work of this section, submit names and documented qualifications of personnel to perform work of this section.
- .3 Submit list of instruments and include serial numbers and calibration certificates.
- .4 Preliminary Report: Submit for checking and approval by DCC Representative before submission of formal report. Include:
 - .1 Details of instruments used.
 - .2 Details of procedures employed.

- .3 Calculations procedures.
- .4 Summaries.
- .5 Testing and Balancing Report:
 - .1 Format in accordance with ANSI/AABC National Standards for Total System Balance, ANSI/ASHRAE 111, NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, SMACNA 1780 and show results in IP or SI units.
 - .2 Include:
 - .1 Project record drawings.
 - .2 System schematics.
 - .3 Submit one (1) electronic copy of the report to DCC Representative.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Test and balance systems regulated by codes to the satisfaction of the authority having jurisdiction.
- .2 Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this section, certified by AABC or NEBB.
- .3 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 During construction, coordinate location and installation of measurement and balancing devices, equipment, accessories, measurement ports, and fittings.
- .2 Calibrate instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate instruments within three months of work. Submit certificate of calibration.
- .4 Notify DCC Representative seven days before start of work.

3.2 VERIFICATION OF CONDITIONS

- .1 Verify that building is substantially complete, including:

- .1 Installation of ceilings, doors, windows, and other construction affecting the Work.
- .2 Application of weatherstripping, sealing, and sealants.
- .3 Pressure, leakage, and other tests specified elsewhere in Division 23.
- .4 Provisions for Work are installed and operational.
- .2 Verify proper, normal, and safe operation of mechanical and associated electrical and control systems affecting Work including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place are clean.
 - .2 Duct systems are clean.
 - .3 Ducts, air shafts, and ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, and volume control dampers are installed and open.
 - .6 Coil fins are combed and clean.
 - .7 Access doors are installed and closed.
 - .8 Outlets are installed and volume control dampers are open.

3.3 SYSTEM START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified in equipment sections.

3.4 ADJUSTING

- .1 Operate systems as required to perform the work and as required by DCC Representative for verification of reports.
- .2 Test to verify proper and safe operation, to determine actual point of performance, and to evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .3 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal loads and operating conditions.
- .4 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

3.5 AIR SYSTEMS

- .1 Test and balance air systems to ANSI/AABC National Standards for Total System Balance, ANSI/ASHRAE 111, NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, SMACNA 1780.

- .2 Take measurements as appropriate for application, including but not limited to air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, and noise.
- .3 Document locations of equipment measurements in report, including:
 - .1 Inlet and outlet of dampers, filter, coil, fan, and other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
 - .3 Main ducts, main branch, sub-branch, and terminals (grille, register or diffuser).

3.6 TOLERANCES

- .1 HVAC systems: +5%, -5% of design.
- .2 Accuracy: +/-2% of actual values.

3.7 SITE QUALITY CONTROL

- .1 Reported results are subject to verification by DCC Representative. Verify number and location of results as directed by DCC Representative.
- .2 Provide personnel and instrumentation to verify up to 50% of reported results.
- .3 Repeat work as required until results fall within specified performance values.

3.8 CLOSEOUT ACTIVITIES

- .1 After work is completed to satisfaction of DCC Representative, replace drive guards, close access doors, lock devices in set positions, and 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes: Materials and methods for pressure testing ducts over 5m in length, forming part of a supply, return, or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 RELATED REQUIREMENTS

- .1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.3 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 ANSI/SMACNA 016-2012, HVAC Air Duct Leakage Test Manual.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing:
 - .1 Test ducts before installation of insulation or other forms of concealment.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit details of test instruments to be used at least two months before anticipated start date.
- .3 Certificates: Submit instrument calibration certificates no more than 21 days before start of tests.
- .4 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 for approval at least two months before proposed date of first series of tests. Do not start tests until approval received in writing from DCC Representative.
 - .2 Prepare report of results and submit 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 testing and balancing report specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.6 QUALITY ASSURANCE

- .1 Work of this Section shall be performed by the same agency as work in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

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 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test Apparatus Accuracy: Within +/-3% of flow rate and pressure.
- .3 Calibration: Calibrate instruments at minimum interval of six months and submit certificates of calibration.

Part 3 Execution

3.1 TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by the system. Pro-rate specified system leakage tolerances.
- .2 Leakage Rates: Leakage shall not exceed 2%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.2 TESTING

- .1 Test when ambient temperature will not affect effectiveness of seals and gaskets.
- .2 Test lengths of ducts consistent with test equipment capacity.
- .3 Test fittings, branch ducts, tap-ins.
- .4 Repair leaks and repeat tests until specified pressures are attained.
- .5 Base partial system leakage calculations on ANSI/SMACNA 016.
- .6 Seal leaks that can be heard or felt, regardless of their contribution to total leakage. Retest after seals have cured.

3.3 CLEANING

- .1 Comply with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Upon completion of work, remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for ductwork and ductwork accessories.

1.2 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Section 23 33 53 – Duct Liners.

1.3 DEFINITIONS

- .1 For purposes of this Section:
 - .1 "Concealed" - means insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "Exposed" - means "not concealed" as previously defined.
 - .3 "Insulation systems" - means insulation material, fasteners, jackets, and other accessories.
 - .4 "Jacketing" - synonymous with cladding and lagging.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM):
 - .1 ASTM C 335/C 335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 449-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .4 ASTM C 612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .5 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .6 ASTM C 1423-21, Standard Guide for Selecting Jacketing Materials for Thermal Insulation.
 - .7 ASTM C 1767M-21, Standard Specification for Stainless Steel Jacketing for Insulation.
- .3 Green Seal Environmental Standards (GS):

- .1 GS-36-13, Green Seal Standard for Adhesives for Commercial Use.
- .4 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1168-17, Adhesive and Sealant Applications.
- .5 Midwest Insulation Contractors Association (MICA):
 - .1 National Commercial and Industrial Insulation Standards Manual.
- .6 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.

1.5 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 datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finishes, and limitations.
- .3 Shop Drawings: Submit drawings.
- .4 Samples:
 - .1 When requested, submit for approval: Complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12-mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .5 Manufacturers' Instructions:
 - .1 Submit manufacturers' duct insulation jointing recommendations and special handling criteria, installation sequence, and cleaning procedures.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section, qualified to standards.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Perform 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, and ULC markings.
- .3 Store at temperatures and conditions recommended by manufacturer.

- .4 Packaging Waste Management: Perform in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 INSULATION

- .1 Mineral Fibre: Glass fibre, rock wool, or slag wool.
- .2 Fire/Smoke Rating: To CAN/ULC-S102.
 - .1 Maximum flame-spread rating: 25.
 - .2 Maximum smoke developed classification: 50.
- .3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335/C 335M.
- .4 Type C-1: Rigid mineral fibre board to CAN/ULC S702.1, ASTM C 612, with factory applied vapour retarder jacket.

2.2 ACCESSORIES

- .1 Vapour Retarder Lap Adhesive: Water based, fire retardant type, and compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C 449.
- .4 Outdoor Vapour Retarder Finishes:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing Fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: Self-adhesive, aluminum, reinforced, 75mm-wide minimum.
- .6 Contact Adhesive: Quick-setting.
- .7 Canvas Adhesive: Washable.
- .8 Tie wire: 1.5mm stainless steel.
- .9 Banding: 12mm-wide, 0.5mm-thick stainless steel.
- .10 Facing: 25mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .11 Fasteners: 4mm-diameter pins with 35mm-square or diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that pressure testing of ductwork systems is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install to manufacturer's instructions, and in accordance with MICA National Commercial and Industrial Insulation Standards Manual.
- .2 Apply materials in accordance with manufacturer's instructions.
- .3 Use two layers of insulation with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes. Duct insulation shall be continuous through wall and ceiling openings and sleeves, except where firestopping is required.
 - .1 Ensure hangers and supports are outside vapour retarder jacket and in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .5 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: Install at 300-mm on centre in horizontal and vertical directions, minimum two rows each side.
- .7 At chilled ductwork, secure with banding. Fasteners penetrating puncturing the underlying vapour barrier are not acceptable.

3.3 SITE QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Replace insulation with vapour barrier damage and moisture-saturated insulation.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation Types and Thicknesses: Conform to following table:

	Type	Vapour Retarder	Thickness (mm)
Indoor air ducts downstream of exhaust fans	C-1	yes	25
Acoustically lined ducts	none	See Section 23 33 53 – Duct Liners	

- .2 Exposed Insulation Finishes:

	TIAC Code	
	<u>Rectangular</u>	<u>Round</u>
<u>Indoor, concealed</u>	<u>none</u>	<u>none</u>

3.5

CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes: Thermal insulation for HVAC piping and piping accessories.

1.2 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Firestopping.
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.3 DEFINITIONS

- .1 For the purposes of this Section:
 - .1 Concealed means insulated mechanical services in suspended ceilings, or in non-accessible chases, or in furred-in spaces.
 - .2 Exposed means not concealed.
 - .3 Jacketing is synonymous with insulation cladding and lagging.
 - .4 Mineral fibre is synonymous with glass fibre, rock wool, or slag wool.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM):
 - .1 ASTM C 335/C 335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 411-19, Standard Specification for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C 449/C 449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C 533-17, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C 547-22a, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .7 ASTM C 1136-21, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - .8 ASTM C 1767M-21, Standard Specification for Stainless Steel Jacketing for Insulation.
- .3 Green Seal Environmental Standards (GS):

- .1 GS-36-13, Adhesives for Commercial Use.
- .4 Midwest Insulation Contractors Association (MICA):
 - .1 North American Commercial and Industrial Insulation Standards (NACIIS) Manual, 9th edition.
- .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.

1.5 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 datasheets. Include product characteristics, performance criteria, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS).
- .3 Shop Drawings:
 - .1 Submit drawings with a list of insulation for each service location, insulation type, thickness, and jacketing type.
- .4 Samples:
 - .1 When requested, submit small samples of PVC showing full range of manufacturer's colours for DCC Representative's initial selection.
 - .2 When requested, submit for review a complete assembly of each type of insulation system, coating, and adhesive. Mount sample on a 12-mm plywood board. Affix label beneath each sample indicating service.
- .5 Certificates: When requested, submit manufacturer's certificates certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions: Submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Protect insulation, canvas, and other moisture-sensitive materials from moisture.

Part 2 Products

2.1 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Combustible piping materials, including adhesives in accordance with CAN/ULC-S102:
 - .1 Flame-spread rating: Maximum 25.
 - .2 Smoke developed classification: Maximum 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335/C 335M.
- .2 Type A-6: Flexible unicellular tubular elastomer.
 - .1 Insulation: With vapour retarder jacket.
 - .2 Jacketing: To ASTM C 921.
 - .3 Maximum "k" factor: 0.039 W/m °C.
 - .4 Certified by manufacturer as free of potential stress corrosion cracking corrosive substances.

2.3 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, plain reinforced, 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.

2.4 JACKETING

- .1 Canvas:
 - .1 220gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
- .2 Stainless steel:
 - .1 Type: 304 or 316, to ASTM C 1767M.
 - .2 Thickness: Minimum 0.25 mm.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50mm laps.
 - .5 Fittings: Minimum 0.5mm-thick die-shaped fitting covers with factory-attached protective liner.

- .6 Jacket banding and mechanical seals: Stainless steel, 19mm wide, minimum 0.5mm thick at 300mm spacing.

2.5 ACCESSORIES

- .1 Weatherproof Sealant for Jackets Installed Outdoors: In accordance with Section 07 92 00 - Joint Sealants.
- .2 Tape: Self-adhesive, aluminum, reinforced, minimum 50mm wide.
- .3 Contact Adhesive: Quick setting type.
- .4 Canvas Adhesive: Washable.
- .5 Tie Wire: Stainless steel, minimum 1.5mm diameter.
- .6 Bands: Stainless steel, 19mm wide, minimum 0.5mm thick.
- .7 Thermal Insulating and Finishing Cement: To ASTM C 449, hydraulic setting or air drying on mineral wool.
- .8 Vapour Retarder Lap Adhesive: Water-based and fire retardant type, compatible with insulation.
- .9 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .10 Outdoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

Part 3 Execution

3.1 PREPARATION

- .1 Verify that pressure testing of piping systems and adjacent equipment is complete, witnessed, and certified.
- .2 Verify that surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install to manufacturer's instructions and in accordance with MICA, North American Commercial and Industrial Insulation Standards (NACIIS) Manual.
- .2 Provide two layers of insulation with staggered joints when required nominal wall thickness exceeds 75mm.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .4 Install piping insulation continuous through wall and ceiling openings and sleeves, except where firestopping is required. Coordinate with Section 07 84 00 - Firestopping.

.5 Supports and Hangers:

- .1 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Install hangers and supports outside vapour retarder jacket.
- .3 Apply high compressive strength insulation that is suitable for HVAC piping service at oversized saddles and shoes where insulation saddles have not been provided.

3.3 INSTALLATION - REMOVABLE PRE-FABRICATED INSULATION AND ENCLOSURES

- .1 At expansion joints, valves, flanges and unions at equipment.
- .2 Install components to permit movement of expansion joint, to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Install insulation, fastenings, and finishes that are compatible with piping system.
- .4 Install stainless steel insulation jacketing.

3.4 INSTALLATION - ELASTOMERIC INSULATION

- .1 Insulation to remain dry.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings, unless otherwise specified.
- .2 Type: A-6.
 - .1 Securements: as per manufacturer's recommendation.
 - .2 Seals: Lap seal adhesive, lagging adhesive.
- .3 Provide insulation thickness as listed in the following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed run-outs to HVAC fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC Code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run-out	to 1	1 ¼ to 2	2 ½ to 4	5 to 6	8 & over
Refrigerant hot gas, suction, liquid	4 – 13	A-6	25	25	25	25	25	25
Refrigerant hot gas, suction, liquid	Below 4	A-6	25	25	38	38	38	38

.4 Finishes:

- .1 Concealed, indoors: Canvas on valves, fittings. No additional finish.
- .2 Outdoors: Waterproof stainless steel jacketing.
- .3 Finish attachments: Stainless steel screws or bands, at 150mm on centre.
- .4 Seals: Wing or Closed.

3.6 SITE QUALITY CONTROL

- .1 Non-Conforming Work: Replace insulation where there is damage to the vapour barrier and insulation is saturated with moisture.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies the Contractor's responsibilities related to commissioning of heating, ventilation and air-conditioning (HVAC) systems and their contribution to the overall commissioning work specified in the relevant Sections of Division 01.
- .2 Construction Team: Contractor is responsible for performing tests and verification activities specified in the relevant Sections of Division 23 and submitting reports to CxA.
 - .1 Subcontractors: HVAC subcontractors and third-party inspection/testing agencies participate in commissioning activities in coordination with site quality control requirements for Work they are providing.
 - .2 Manufacturers: manufacturers assist verification activities and report on installation, performance and operation of the products/systems they supplied, as specified in the relevant Sections of Division 23.
 - .3 Contractor coordinates the work of subcontractors, inspection/testing agencies and manufacturers with the commissioning requirements of this Section.
- .3 Commissioning Authority (CxA): the CxA may assign a commissioning specialist with expertise in building mechanical systems and controls, to undertake its commissioning responsibilities related to this Section.
- .4 DCC Representative will designate a person to represent the interests of the facility related to work specified in relevant Sections of Division 23.
 - .1 DCC Representative may designate an additional representative to participate in the commissioning process and facilitate the transfer of HVAC systems to the facility's O&M staff.
- .5 The requirements of this Section do not replace testing requirements specified in the relevant Sections of Division 23, or reporting activities to demonstrate compliance with building code requirements to the authorities having jurisdiction (AHJ).

1.2 ACRONYMS

- .1 BMM - Building Management Manual
- .2 CT - Construction Team
- .3 Cx - Commissioning
- .4 CxA - Commissioning Authority
- .5 EMCS - Energy Monitoring and Control Systems
- .6 FPT - Functional Performance Testing
- .7 HVAC - Heating, Ventilation and Air-Conditioning
- .8 O&M - Operation and Maintenance

- .9 TAB - Testing, Adjusting and Balancing

1.3 DEFINITIONS

- .1 Construction Team: the term Construction Team is used in this Section to designate inclusively the Contractor, subcontractors, manufacturers/suppliers and other support disciplines that are responsible for construction/installation of the Work specified in these specifications.
- .2 Cx Forms: forms used to document the inspections, tests and verification activities performed during the commissioning process, as specified in Section 01 91 13 - General Commissioning Requirements.
- .3 Cx Plan: a document developed under the responsibility of the CxA to specify the project's commissioning requirements, as specified in Section 01 91 13 - General Commissioning Requirements.
- .4 Cx Team: the commissioning team consists of project members that participate in the development, refinement and execution of the Cx Plan, as specified in Section 01 91 13 - General Commissioning Requirements.

1.4 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process.
- .2 CSA Group (CSA)
 - .1 CSA Z320-11, (R2021), Building Commissioning.
 - .2 CSA Z5000-18, Building Commissioning for Energy Using Systems.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Construction Team - Cx Representative: Contractor to designate a person from the Construction Team to review and coordinate commissioning activities specified in this Section.
 - .1 Representative to be acceptable to CxA with the following qualifications:
 - .1 Technical personnel testing and commissioning of HVAC systems.
 - .2 Site supervisor or project manager within the Construction Team, with direct responsibilities for supervising the execution of work specified in the relevant Sections of Division 23.
- .2 Coordination: coordinate the responsibilities of the Construction Team in the Cx process with the responsibilities of other participants that form part of the Cx Team.
 - .1 Coordinate the participation of HVAC subcontractors, inspection/testing agencies and manufacturers in reviewing the Cx Plan, submittals and in assisting testing and demonstration activities related to their work.
 - .2 Coordinate commissioning activities with execution of the work during the course of construction to allow Cx participants and the AHJ to fulfill their responsibilities for witnessing tests and reviewing installation before concealment of work.
 - .3 Review interfaces with other work to ensure submittals and installation requirements are coordinated with other trades, including:
 - .1 Control devices to be installed on HVAC systems.

- .2 Electrical distribution serving HVAC equipment, including disconnects and starters, as specified in the relevant Sections of Division 26.
 - .3 Requirements for fire alarm shutdown relays on HVAC equipment and for smoke control systems operation as specified in the relevant Sections of Division 28.
- .3 Notification: notify the CxA of activities associated with the commissioning process in accordance with Section 01 91 13 – General Commissioning Requirements.
- .4 Commissioning Conferences: arrange commissioning meetings attended by CxA, Contractor and HVAC subcontractor in accordance with Section 01 91 13 – General Commissioning Requirements and as follows:
 - .1 Before starting work: to review mock-up requirements and factory testing of systems, components and/or equipment.
 - .2 Coordination of integrated systems: to review and coordinate interfaces of HVAC equipment and control devices and to ensure they connect with systems provided and specified in the relevant Sections of Division 25.
 - .3 During execution of work but before start of commissioning activities: to refine the Cx Plan, commissioning documentation and commissioning schedule.
- .5 Sequencing: perform commissioning activities in general accordance with the commissioning process described in CSA Z320 and CSA Z5000, maintaining the systematic approach to completing and obtaining acceptance for each phase of commissioning in particular with regards to static verification, start-up and functional performance testing.
 - .1 Functional Performance Testing (FPT): perform operational and performance testing by phases starting with individual components and equipment, testing of sub-systems and then proceeding to FPT of overall systems.
 - .2 Integrated Systems: only perform commissioning of integrated systems once the FPT for each individual system forming part of the integrated system has been completed.
 - .3 Demonstration and training activities may form part of certain commissioning activities, as agreed by CxA.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 HVAC Cx Schedule:
 - .1 Submit proposed schedule before start of commissioning conferences indicating key activities critical to the commissioning process including:
 - .1 Inspection of HVAC systems.
 - .2 Testing, flushing and cleaning of HVAC piping and ductwork.
 - .3 TAB activities in accordance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
 - .4 Commissioning phases: static verification, start-up, functional performance testing, systems orientation, O&M manuals submissions, training sessions.
 - .5 Integrated Testing activities.
 - .2 Review the proposed schedule through the course of the work and notify CxA of modifications required.
- .3 Commissioning Forms: Contractor to review and complete forms for documenting static verification and start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.

- .1 Approved Cx Forms: CxA reviews and approves the final format to use through the commissioning process.
 - .1 Review the forms proposed by CxA and submit comments with proposed adjustments.
 - .2 Contractor may submit its own preferred format for review by the CxA. This may include manufacturer provided checklists.
- .2 Submit completed static verification and start-up checklists within 48 hours of completion of verification of equipment or system.
- .4 Testing Equipment: submit a list of proposed testing equipment for performing HVAC Cx activities and related tests in accordance with Section 01 91 13 - General Commissioning Requirements.
- .5 Site Quality Control Submittals: submit manufacturers written certificates and reports demonstrating compliance of Work, as specified in the relevant Sections of Division 23.
- .6 Training Program: submit proposed training program and materials in accordance with Section 01 79 00 - Demonstration and Training and Section 01 91 13 - General Commissioning Requirements.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit O&M data and as-built information in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Site Modifications: record changes to installations, system configuration and/or controls that were made during the commissioning process to meet the required performance of HVAC equipment and systems.

Part 2 Products

2.1 EQUIPMENT

- .1 Furnish special tools or equipment required for:
 - .1 Verifying or adjusting equipment/system components.
 - .2 Accessing equipment, enclosures or control cabinets.
 - .3 Interfacing with equipment controls or system integrated diagnostics.
- .2 Furnish instruments and equipment required to perform testing and validate performance of HVAC systems through the commissioning process or as specified in the relevant Sections of Division 23.

Part 3 Execution

3.1 STATIC VERIFICATION

- .1 Perform static verification of components, equipment and systems in accordance with Section 01 91 13 – General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Verify installation and connection of equipment, sub-systems and systems.
 - .2 Confirm proper location of valves, sensors and control components in accordance with design and O&M requirements.

- .3 Confirm accessibility to HVAC equipment and components for inspection and O&M activities.
- .4 Conduct hydrostatic pressure testing of refrigerant piping and report results.
- .5 Conduct pressure testing and leakage tests of HVAC ductwork and report results.
- .6 Record equipment and systems information including: manufacturer, model number, serial number and rated capacities.
- .7 Confirm completion of labelling and identification of piping, valves, ductwork, equipment and control components.
- .8 Confirm completion and documentation of equipment prestart-up tests, including manufacturer's factory tests.
- .9 Confirm adequate protection of HVAC systems during construction.
- .10 Confirm that thermal insulation of HVAC systems is completed in accordance with design requirements.
- .11 Confirm seismic and vibration controls for HVAC equipment/systems are installed in accordance with design details and manufacturer's recommendations.
- .2 Site Quality Control: CxA to conduct random verification on-site to validate the accuracy of static verification reporting. Contractor to assist the CxA on site to review selected samples representing up to 50% of the overall installation.

3.2 START-UP

- .1 Perform start-up of equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Cleaning of HVAC ductwork.
 - .2 Contractor/manufacturer start-up of equipment.
 - .3 Electrical start-up of equipment including site electrical tests and verification of overloads and motor rotation.
 - .4 Confirm equipment electrical wiring diagrams are provided within the unit's electrical or controls enclosure.
 - .5 Visual and mechanical inspections following equipment start-up.
 - .6 Verify proper staging control of multi-stage equipment and modulation of equipment supplied with variable control.
 - .7 Verify operation of safety controls and interlocks.
 - .8 Complete inspections required by authorities having jurisdiction.
 - .9 Verify temperature performance of ventilation systems.
 - .10 Verify refrigerant charges.
- .2 Site Quality Control: CxA will witness start-up activities for selected equipment. Notify CxA of start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- .1 Perform Functional Performance Testing (FPT) on HVAC equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and as directed by CxA.
- .2 Operate equipment as directed by CxA to demonstrate and validate that equipment, sub-systems and systems function and perform in accordance with design requirements.
- .3 FPT of HVAC systems to take place during four consecutive seasons to allow testing/verification of systems sensitive to occupancy and seasonal changes.

- .1 Perform initial FPT of HVAC systems, as part of commissioning process.
- .2 Repeat FPT activities during four consecutive seasons after facility has been accepted, taken over and fully occupied.
- .4 FPT activities include:
 - .1 Verify proper operation of HVAC systems and equipment in the following modes of operation:
 - .1 Systems operation on normal power.
 - .2 Normal operation - no alarm conditions.
 - .3 Systems operation in alarm condition.
 - .4 Manual operation mode.
 - .5 Automatic operation mode.
 - .2 Verify operation of safety cutouts, alarms and interlocks.
 - .3 Confirm alarms are generated and transmitted effectively to the intended notification system (e.g., pilot light, control panel, EMCS, remote surveillance system).
 - .4 Confirm capacities of heating and cooling systems at design conditions: first at near winter design conditions and then under near summer design conditions.
 - .5 Verify that the proper schedules were configured for each HVAC equipment and confirm that they are disabled or set back when not required.
 - .6 Verify operation of HVAC equipment running on dual energy sources and optimize controls responsible for switching energy sources.
 - .7 Confirm that simultaneous heating and cooling is not occurring at an equipment level.

3.4 CX OF INTEGRATED SYSTEMS

- .1 Operate equipment as directed by CxA to perform commissioning of integrated systems.

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: obtain written certificates and reports from manufacturer verifying compliance of Work and submit Manufacturer's Site Reports as described in PART 1 - SUBMITTALS.
 - .1 Provide manufacturer's site services to complete start-up activities and assist in Functional Performance Testing as specified in the relevant Sections of Division 23.

3.6 CLOSEOUT ACTIVITIES

- .1 Corrections: Provide equipment, materials and labor as required to correct installation and/or equipment deficiencies identified through the commissioning process.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 22 05 15 - Plumbing Specialties and Accessories.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Performance Verification Reports: Submit in accordance with Section 01 91 13 - General Commissioning Requirements. Supplement reports as specified in this Section.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 GASEOUS FUEL SYSTEMS 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, and alarms.
- .4 Check terminals of vents for gas pressure regulators.

3.2 CONDENSATE DRAINAGE SYSTEMS TESTS

- .1 Ensure that fixtures are properly anchored and connected to system.
- .2 Operate each fixture to verify drainage and no leakage.
- .3 Cleanouts: Refer to Section 22 05 15 - Plumbing Specialties and Accessories.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes: materials and installation for piping, valves and fittings for gas fired equipment.

1.2 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework.
- .2 Section 23 08 13 - Performance Verification.

1.3 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.5-20, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard.
 - .2 ASME B16.18-18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-18, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-12, Square and Hex Bolts and Screws Inch Series.
- .2 ASTM International (ASTM):
 - .1 ASTM A 47/A 47M-99(2018)e1, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-20, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B 75M-20, Standard Specification for Seamless Copper Tube (Metric).
 - .4 ASTM B 837-19, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 CSA Group (CSA):
 - .1 CAN/CSA B149.1HB:20, Natural Gas and Propane Installation Code Handbook.
 - .2 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
 - .3 CSA B137.4:20, Polyethylene (PE) Piping Systems for Gas Services.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Safety Data Sheets (SDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product literature, specifications and datasheet for piping, fittings and equipment.

- .2 Indicate on manufacturers catalogue literature following: valves.
- .3 Submit WHMIS SDS. Indicate VOC's for adhesive and solvents during application and curing.
- .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.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week before beginning work of this section and on-site installations.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
- .2 Health and Safety:
 - .1 Do construction in accordance with occupational health and safety.

Part 2 Products

2.1 PIPING ABOVE GROUND

- .1 Steel pipe: to ASTM A 53/A 53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Fittings
 - .1 Steel pipe fittings, screwed, flanged or welded:
 - .2 Malleable iron: screwed, banded, Class 150.
 - .3 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .4 Welding: butt-welding fittings.
 - .5 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A 47M.
 - .6 Bolts and nuts: to ASME B18.2.
 - .7 Nipples: schedule 40, to ASTM A 53/A 53M.
- .3 Joining Material

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to ASTM B 837.

.4 Valves

- .1 Provincial Code approved, lubricated ball type.

2.2 PIPING BELOW GROUND

- .1 Polyethylene piping, tubing and fittings shall only be used underground. All polyethylene piping must comply with CSA B-137.4.
- .2 Transition fittings from polyethylene to steel must occur below grade.
- .3 Provide metal pipe sleeve when penetrating through pavement and concrete.
- .4 Underground polyethylene piping shall have a tracer wire attached. Tracer wire shall be 14 gauge wire taped along length of polyethylene piping.

Part 3 Execution

3.1 PIPING

- .1 Install in accordance with Section 23 05 15 – Common Installation Requirements for HVAC Pipework, applicable Provincial Codes, CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.2 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by DCC Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment.

3.3 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Obtain reports within three (3) working days of review and submit immediately to DCC Representative.
- .3 Performance Verification:

- .1 Refer to Section 23 08 13 - Performance Verification.
- .4 PV procedures:

- .1 Test performance of components.

3.4 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.

3.5 CLEANING

- .1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.
- .2 Perform cleaning operations as specified in Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 – Waste Management and Disposal and in accordance with manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 15 – Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International (ASTM):
 - .1 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B 280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group (CSA):
 - .1 CSA B52:23, Mechanical Refrigeration Code.
- .4 Environment Canada (EC):
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with contractor's representative and DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building construction subtrades.
 - .4 Review manufacturer's written 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 instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .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.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping or incorporation into manual.
- .3 Submit one (1) electronic copy of operation and maintenance manual.

1.6 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 refrigerant piping, fittings and equipment 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280, type ACR B.
 - .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070kPa and temperature 121°C.
- .2 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.
- .3 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.
- .4 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 22mm 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 22mm: 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 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for refrigerant piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 GENERAL

- .1 Install in accordance with CSA B52, EPS 1/RA/1 and ASME B31.5, Section 23 05 15 – Common Installation Requirements for HVAC Pipework.

3.4 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.

3.5 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction, hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

3.6 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 2 MPa and 1 MPa 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.

3.7 SITE QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.

- .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 hours.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to DCC Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to DCC Representative.
- .9 Manufacturer's Site Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .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, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the 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 the Work, after cleaning is carried out.

- .4 Obtain reports, within 3 days of review, and submit, immediately, to DCC Representative.

3.8 DEMONSTRATION

- .1 Instructions:
 - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal .
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 84 00 - Fire Stopping.
- .2 Section 07 92 00 - Sealants.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
 - .1 ASTM A 480/A 480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-11, 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, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 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 ducts 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.
- .4 Test and Evaluation Reports:
 - .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.

1.4 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 metal ducts 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	A
- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.2 SEALANT

- .1 Sustainability Characteristics:
 - .1 Adhesives and sealants: in accordance with Section 07 92 00 - Sealants.
- .2 Sealant: 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, 50mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNAHVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius or five-piece, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 407mm: with single thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 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 volume control damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .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 - Fire Stopping.
- .2 Coordinate with 07 84 00 - Fire Stopping to ensure fire stopping materials and installation does not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653MZ90 zinc coating.
- .2 Unless otherwise noted on drawings, thickness, fabrication and reinforcement: to ASHRAE, SMACNA.
- .3 Joints: to ASHRAE, SMACNA, proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a 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.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA, following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
 - .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .3 For steel beams: manufactured beam clamps:

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 duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100mm beyond insulated duct.
 - .2 Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE and 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 acoustic duct lining.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE, SMACNA, as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000

3.4 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNAHVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 3m long with not less than two (2) branch takeoffs or two (2) 90 degrees elbows.

- .7 Complete test before performance insulation or concealment Work.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
 - .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 & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 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 air duct accessories 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

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 1.3kg/m².

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 0.6mm thick complete with sheet metal angle frame and 25mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .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 Hold open devices.

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA.

2.5 INSTRUMENT TEST

- .1 1.6mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28mm 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 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .2 Length of connection: 100mm.
 - .3 Minimum distance between metal parts when system in operation: 75mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 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:
 - .1 Size: 300 x 300mm.
 - .2 Locations:
 - .1 Control dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
- .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 exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.

- .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by DCC Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 – Waste Management and Disposal.
 - .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 and Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning and Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

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 dampers for incorporation into manual.

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 dampers 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

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 recommendations of SMACNA, except maximum height 100mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .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: 100mm.
- .4 Bearings: pin in bronze bushings or self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 2% at 500Pa.

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 damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install where indicated on drawings.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by DCC Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
 - .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 & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .4 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 23 33 00 - Air Duct Accessories.
- .2 Section 25 30 02 – EMCS: Field Control Devices.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

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 dampers 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 dampers 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 in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed or parallel blade type as indicated on drawings.
- .2 Structurally formed steel or extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or 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: to Section 25 30 02 – EMCS: Field Control Devices.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.
 - .2 Pressure drop: at full open position less than 25 Pa differential across damper at 10 m/s.
- .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.

2.2 DISC TYPE DAMPERS

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653/A 653M.
- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653/A 653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10-year warranty.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 500Pa pressure differential across damper.
 - .2 Pressure drop: at full open position less than 25 Pa differential across damper at 10 m/s.

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 damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install where indicated on drawings.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
 - .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 & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C 177-13, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - .2 ASTM C 423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM C 916-20, Standard Specification for Adhesives for Duct Thermal Insulation.
 - .4 ASTM C 1071-19, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .5 ASTM C 1338-19, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .6 ASTM G 21-15(2021)e1, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 90A-21, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-21, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .3 North American Insulation Manufacturers Association (NAIMA):
 - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-2006.
 - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2007.
- .5 Thermal Insulation Association of Canada (TIAC):
 - .1 Mechanical Insulation Best Practices Guide.
- .6 Underwriter's Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building 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, product literature and data sheets for duct liners and include product characteristics, performance criteria, physical size, finish and limitations.

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 duct liners for incorporation into manual.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .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 duct liners from moisture damage.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 DUCT LINER

- .1 General:
 - .1 Mineral Fibre duct liner: air surface coated mat facing.
 - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102, NFPA 90A and NFPA 90B.
 - .3 Recycled Content: EcoLogo certified.
 - .4 Fungi resistance: to ASTM C 1338 and ASTM G 21.
- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25mm thick, to ASTM C 1071 Type 2, fibrous glass rigid board duct liner.
 - .3 Density: 48kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.76 (m². degrees C)/W for 25mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature
 - .5 Maximum velocity on faced air side: 20.3m/s.
 - .6 Minimum NRC of 0.70 at 25mm thickness based on Type A mounting to ASTM C 423.
 - .7 Recycled Content: EcoLogo certified.

2.2 ADHESIVE

- .1 Adhesive: to NFPA 90A, NFPA 90B and ASTM C 916.

- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.

- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0mm diameter, length to suit thickness of insulation. Metal retaining clips, 32mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for duct liner installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 GENERAL

- .1 Install ductwork and plenum insulation and accessories per the TIAC Mechanical Insulation Best Practices Guide. Where the Contract Documents differ from the TIAC Mechanical Insulation Best Practices Guide, the Contract Documents shall govern.
- .2 Do work in accordance with SMACNA HVAC Duct Construction Standard and NAIMA AH116.
- .3 Line inside of ducts where indicated.
- .4 Duct dimensions, as indicated, are clear inside duct lining.

3.3 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C 916.

- .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC Duct Construction Standard and NAIMA AH116.
- .2 In systems, where air velocities exceed 20.3m/s, install galvanized sheet metal noising to leading edges of duct liner.

3.4 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of DCC Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .2 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):
 - .1 ANSI/AMCA Standard 99-16, Standards Handbook.
 - .2 ANSI/ASHRAE 51-16 (ANSI/AMCA 210-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 210-16, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - .4 ANSI/AMCA Standard 300-14, Reverberant Room Method for Sound Testing of Fans.
 - .5 ANSI/AMCA Standard 301-14, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manua.
 - .1 MPI #18, Primer, Zinc Rich, Organic.

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 HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide:
 - .1 Fan performance curves showing point of operation, bhp and efficiency.
 - .2 Sound rating data at point of operation.
 - .2 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controller.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Parts:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

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, in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
 - .2 Store and protect HVAC fan from nicks, scratches, and blemishes.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .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.
 - .1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, and as indicated on schedule.
 - .2 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300.
 - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210.

2.2 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.
 - .3 Sizes as indicated on drawings.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .4 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 POST-DISCHARGE PURGING FANS (EF-1/3)

- .1 Configuration: inline duct fans, as indicated on drawings.
- .2 Backward curved impellers which greatly reduce operating noise levels.
- .3 Handles high static pressure.
- .4 Heavy gauge drawn steel housing epoxy coated inside and out for superior corrosion protection.
- .5 Maintenance free and energy efficient external rotor motor.

2.4 CEILING-MOUNTED VENTILATORS (EF-2/4)

- .1 Configuration: Ceiling bottom inlet grille and side outlet connection for 4.5 x 18.5 inch (114 x 470 mm) duct, as indicated on drawings.
- .2 Housing: 20 Ga, 0.0396 inch (1.0 mm) galvanized steel.
- .3 Blower Wheel: Double wheel, impact resistant polymeric construction.
- .4 Inlet Grille: White steel, painted.
- .5 Integral gravity backdraft damper.
- .6 1/2 inch (13 mm) acoustic insulation lining.
- .7 Suitable for ceiling mounting.
- .8 Provide eight-position mounting brackets.
- .9 Accessories
 - .1 Wall Cap:
 - .1 Round Inlet Duct: Provide galvanized steel with aluminum louvers weatherproof outlet, suitable for wall mount, with integral backdraft damper and with integral bird screen.
 - .2 Controls
 - .1 Remote Mounted Speed Control: Manual dial speed control suitable for mounting in single gang box.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for HVAC fan installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

- .1 Install fan as indicated, complete with resilient mountings, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Bearings and extension tubes to be easily accessible.
- .3 Access doors and access panels to be easily accessible.

3.3 SITE QUALITY CONTROL

- .1 Refer to Section 01 91 13 – General Commissioning Requirements.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASHRAE Standard 70 – Method of Testing the Performance of Air Outlets and Air Inlets.
- .2 ASTM 610 – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.
- .3 ASTM 714 – Test Method for Evaluating Degree of Blistering of Paints.
- .4 ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
- .5 ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- .6 ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub.

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, product literature and data sheets for registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

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, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect registers and grilles from nicks, scratches, and blemishes.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 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.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard.

2.3 MANUFACTURED UNITS

- .1 Grilles and registers, of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES (SG-1/2) AND TRANSFER GRILLE (TG-1)

- .1 The grille blades and border shall be steel construction.

- .2 Grilles shall be double deflection louver type and shall have two (2) sets of fully adjustable blades with ½ inch on center blade spacing.
- .3 The grille front blades shall be parallel to the long dimension.
- .4 Paint finish shall be baked-on powder coat finish.
 - .1 The paint film thickness shall be a minimum of 2 mils.
 - .2 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
 - .3 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
 - .4 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
 - .5 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.

2.5 RETURN REGISTER (RG-1)

- .1 The register shall be aluminum construction, consisting of an extruded aluminum border and an aluminum ½ x ½ x ½ inch grid egg crate core.
- .2 Paint finish shall be baked-on powder coat finish.
 - .1 The paint film thickness shall be a minimum of 2 mils.
 - .2 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
 - .3 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
 - .4 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
 - .5 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.
- .3 The register shall be supplied with an aluminum with mill finish opposed blade damper. The damper shall be operable from the register face.

2.6 EXHAUST REGISTERS (EG-1/2)

- .1 The grille blades and border shall be steel construction.
- .2 Grilles shall be 45 degree deflection fixed louver type to minimize see-through and shall have one (1) set of fixed blades with ½ inch on center blade spacing.
- .3 Blades shall be parallel to the long dimension.
- .4 Paint finish shall be baked-on powder coat finish.
 - .1 The paint film thickness shall be a minimum of 2 mils.

- .2 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
- .3 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
- .4 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
- .5 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.
- .5 The register shall be supplied with a coated steel opposed blade damper. The damper shall be operable from the register face.

2.7 DOOR GRILLE (DG-1)

- .1 Core and frame material shall be steel.
- .2 Paint finish shall be baked-on powder coat finish.
 - .1 The paint film thickness shall be a minimum of 2 mils.
 - .2 The finish shall have a hardness of 2H as tested in accordance with ASTM D3363.
 - .3 The finish shall pass an ASTM B117 Corrosive Environment Salt Spray Test for 1000 hours with no measurable creep, rusting or blistering as per ASTM D1654, D610 and D714.
 - .4 The finish shall pass an ASTM D870 Water Immersion test of a minimum of 500 hours with no measurable with no rusting or blistering as per ASTM D610 and D714.
 - .5 The finish shall have an impact resistance of 100 inch-pounds in accordance with ASTM D2794.

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 register and grille installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Support grilles and registers to structural elements independently from ceilings.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .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 GENERAL

- .1 This section includes the design, controls and installation requirements for packaged rooftop unit.

1.2 QUALITY ASSURANCE

- .1 Unit shall be certified by ETL and ETL Canada listed.
- .2 Unit nameplate shall include the ETL/ETL Canada label. The nameplate, safety labels and warnings shall be in English and French.

1.3 SUBMITTALS

- .1 Product Data: Literature shall be provided that indicates dimensions, operating and shipping weight, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.
- .2 Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Unit shall be shipped with doors bolted shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
- .2 Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- .3 Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.5 WARRANTY

- .1 Manufacturer shall provide a limited “parts only” warranty for a period of 24 months from the date of original equipment shipment from the factory. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer’s written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

1.6 STARTUP REPAIR PROGRAM

- .1 Manufacturer shall provide startup repair for a period of 12 months from the date of original equipment shipment from the factory. Program shall cover labor for materials and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation and maintenance have been followed. Program excludes labor associated with routine maintenance, such as belt and air filter replacement.

Part 2 Products

2.1 GENERAL

- .1 Outdoor air unit shall include filters, supply fan, dampers, electric heater, and unit controls.
- .2 Unit shall be factory assembled and tested including run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
- .3 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
- .4 Unit components shall be labeled, including electrical and controls components.
- .5 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
- .6 Installation, Operation and Maintenance manual shall be supplied within the unit.
- .7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
- .8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

2.2 CONSTRUCTION

- .1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
- .2 Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 320°C (610°F).
- .3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break shall prevent moisture accumulation on the insulation, provide a cleanable interior, reduce heat transfer through the panel, and prevent exterior condensation on the panel.
- .4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 210/240. Panel deflection shall not exceed L/240 ratio at 125% of

design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

- .5 Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
- .6 Access to filters, dampers, heater, and electrical and controls components shall be through hinged access doors with quarter turn, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
- .7 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
- .8 All openings through the unit shall have upturned flanges of at least 12mm (1/2 inch) around the opening.
- .9 Unit shall include lifting lugs on the top of the unit.

2.3 ELECTRICAL

- .1 Unit shall have a 10kAIC SCCR.
- .2 Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
- .3 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.4 SUPPLY FAN

- .1 Unit shall include a direct drive, unhooded, backward curved, plenum supply fan.
- .2 Blower and motor shall be dynamically balanced.
- .3 Motor shall be a high efficiency electrically commutated motor.
- .4 Motor shall include shaft grounding.

2.5 ELECTRIC HEATING

- .1 Unit shall include an electric heater consisting of electric heating coils, fuses and a high temperature limit switch, with capacities as shown on the plans.
- .2 Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). Supply air temperature sensor shall be factory provided, and field installed in the supply air ductwork. A setpoint adjustment potentiometer shall be factory provided.

2.6 FILTERS

- .1 Unit shall include 50mm (2 inch) thick, pleated panel filters with an ASHRAE MERV rating of 8.
- .2 Unit shall include a clogged filter switch.

2.7 OUTDOOR AIR

- .1 Unit shall include 100% motor operated outdoor air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals.
- .2 Damper blades shall be gear driven and designed to have no more than 15 cfm of leakage per sq. ft. of damper area when subjected to 500 Pa (2 inches w.g.) air pressure differential across the damper.
- .3 Damper assembly shall be controlled by spring return, 2 position actuator.
- .4 Unit shall include outdoor air opening bird screen and outdoor air hood with rain lip.

2.8 CONTROLS

- .1 Factory Installed DDC Terminal Strip for Connection by BAS.
 - .1 Controls shall be furnished by others and field installed.
 - .2 Terminal strips for unit function shall be provided, including factory installed isolation relays.

2.9 ACCESSORIES

- .1 Unit shall be provided with a safety shutdown terminal block for field provision of a remote signal which shuts off the unit's control circuit.

2.10 CURB

- .1 Curb shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.
- .2 Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- .3 Curb shall be furnished fully assembled.

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 energy recovery equipment installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of the DCC Representative.
- .2 Inform the DCC Representative 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 the DCC Representative.

3.2 INSTALLATION

- .1 Installation, Operation and Maintenance manual shall be supplied with the unit.
- .2 Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- .3 Support independently of adjacent ductwork with flexible connections.

3.3 COORDINATION

- .1 Coordinate with the EMCS Contractor and manufacturer to ensure the required controls that are show on Drawing 450 and indicated in Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequences of Operations are implemented.

3.4 STARTUP SERVICES

- .1 Engage factory authorized service technician to start up and commission units. Provide start up report to the DCC Representative.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and 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 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B52 Mechanical Refrigeration Code.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
- .4 American Bearing Manufacturer's Association (ABMA)
 - .1 ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
 - .2 ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- .5 Air Movement and Control Association (AMCA)
 - .1 AMCA 210, Laboratory Method of Testing Fans for Aerodynamic Performance Rating (ASHRAE)
 - .2 AMCA 300 Reverberant Room Method for Sound Testing of Fans.
- .6 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.
 - .2 ANSI/ASHRAE 90.1-2022, Standard for Sites and Buildings Except Low-Rise Residential Buildings.
 - .3 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .7 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA MG1 Motors and Generators.
 - .2 NEMA ICS 7-1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 All equipment shall be delivered, stored, and handled in accordance with the manufacturer's recommendations.
- .2 Outdoor, indoor and controls shall be protected from weather, moisture, and physical damage during storage.
- .3 Units shall be stored in a dry, covered, and temperature-controlled environment.
- .4 Lifting, stacking, and moving instructions printed on the packaging and in the manufacturer's documentation shall be strictly followed.
- .5 Any unit showing signs of damage or improper handling shall be reported and inspected prior to installation.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 35 43 – Environmental Protection and Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Section 01 35 43 – Environmental Protection and Section 01 74 00 - Cleaning & Waste Management and Section 01 74 19 – Waste Management and Disposal.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by DCC Representative.
- .4 Divert unused paint material from landfill to official hazardous material collections site approved by DCC Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Provide one (1) spare set of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed for startup and commissioning. Immediately prior to acceptance by DCC Representative, supply one (1) complete set of filters for each filter unit or filter bank.

1.7 WARRANTY

- .1 The units shall have a manufacturer's parts warranty for a period of two (2) years from date of installation. The compressor shall have a warranty of seven (7) years from date of installation.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 The system is a variable capacity, DX (Direct Expansion), inverter-driven, single-zone split system as specified.
- .2 The system shall consist of a horizontal discharge, single-phase outdoor unit utilizing R-32 refrigerant, paired with a matched-capacity indoor unit.
- .3 The indoor unit shall be equipped with a wired wall-mounted controller for user interface and control.

- .4 The system shall be interconnected via refrigerant piping and control wiring, ensuring seamless communication and efficient operation.

2.2 PERFORMANCE AND EFFICIENCY

- .1 The system shall meet or exceed the following minimum efficiency ratings:
 - .1 Seasonal Energy Efficiency Ratio (SEER2): up to 27.
 - .2 Energy Efficiency Ratio (EER2): up to 12.
 - .3 Heating Seasonal Performance Factor (HSPF2 Region IV): up to 11.
 - .4 COP @ 15°C (5°F): 2.6.
 - .5 >70% Heating Capacity at 15°C (5°F).
- .2 The system shall be capable of delivering capacities as specified in the equipment schedule.
- .3 The system shall be AHRI certified and comply with applicable DOE, EPA and ETL regulations for systems using R-32, a low-GWP refrigerant.
- .4 The system should be able to deliver 100% cooling down to -40°C (-40°F). Front wind baffles shall be supplied as standard with the unit.

2.3 QUALITY ASSURANCE

- .1 Electrical Compliance
 - .1 All system wirings shall comply with the National Electrical Code (NEC) and local jurisdictional requirements.
 - .2 Dual point power between indoors and outdoors is recommended to avoid communication interference.
- .2 Manufacturing Standards
 - .1 The indoor and outdoor units shall be manufactured in facilities certified to ISO 9001 (Quality Management Systems) and ISO 14001 (Environmental Management Systems), ensuring consistent product quality and environmental responsibility.
- .3 Safety and Compliance Certifications
 - .1 The units shall be Intertek ETL Listed for Canada, indicating compliance with the applicable safety standards for heating and cooling equipment, including:
 - .1 CSA C22.2 NO. 60335-2-40:22.
- .4 Performance Certification
 - .1 The units shall be certified by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - .2 Performance ratings shall be based on testing in accordance with AHRI Standard 210/240-2023.

2.4 OUTDOOR UNIT

- .1 General
 - .1 The outdoor unit capacity shall be matched to the indoor unit to ensure optimal performance and load handling as per the design requirements. If not matched properly, it will cause communication issues.
 - .2 All accessories and components shall be manufacturer-approved and fully compatible.

- .3 The outdoor unit shall be factory assembled, piped, wired, and run-tested prior to shipment.
- .4 An integrated electronic control board shall manage all operational functions and interface with the indoor unit.
- .5 All control functionalities should be pre-configured at the factory.
- .6 The unit shall support low ambient cooling operation down to -40°F (-40°C).
- .7 The unit shall support low ambient heating operations down to -13°F (-25°C).
- .8 The unit shall support no ambient temperature cut-off.
- .9 The unit shall have enhanced defrost to ensure cold climate-high humidity operations.
- .10 The unit shall have a sound pressure rating not exceeding 59 dB(A) under standard conditions.
- .11 The system shall utilize a single refrigerant circuit and be factory charged with R-32 refrigerant.
- .12 The system shall adopt a DC motor with 16-speed control, enabling precise airflow adjustment and enhanced energy efficiency.
- .13 The system shall support four-direction piping options for flexible installation in various site conditions.
- .14 The system shall include a base pan heater installed on the outdoor unit chassis to prevent ice buildup and enhance heating capacity in low ambient conditions.
- .15 The system shall utilize advanced multipulse control to pre-heat the compressor in low ambient conditions, ensuring reliable cold-weather startup and operation.
- .16 The unit shall be equipped with an electrical box enclosure that protects against dust, moisture, and physical damage, ensuring reliable operation, easier maintenance, regulatory compliance, and extended component lifespan.
- .17 The system shall have a communication protocol and network compatible for both indoor and outdoor units, with no adapter required for integration into centralized control networks.
- .18 The system shall include control board I/Os on indoor and outdoor units to support flexible application control
- .19 The unit shall not require filter dryer for installation.
- .2 Unit Cabinet
 - .1 The unit casing shall be constructed from galvanized steel and finished with a baked enamel coating. The cabinet shall include removable service panels to provide access to all major components for maintenance and servicing.
 - .2 The unit shall be equipped with a rigid mounting base to ensure the unit remains secure and stable during operation, including under vibration and wind loading conditions.
 - .3 The outdoor coil shall be protected with a factory-applied corrosion-resistant treatment. The coating shall be tested in accordance with ASTM B-117 salt spray test procedures for a minimum of 500 hours to ensure durability in coastal and corrosive environments.
 - .4 The unit shall include multi-point diagnostics, accessible via a user-friendly service board located at the front of the unit.
 - .1 Monitoring real-time operation data.
 - .2 Displaying fault codes for efficient troubleshooting.
 - .3 Record operational data and export.

- .4 Startup and diagnostic support.
- .5 The unit shall include wind baffles and snow hoods to ensure reliable operation in extreme weather conditions.
- .6 The unit shall include the following factory-installed safety and control devices:
 - .1 Pressure switch – for high/low refrigerant pressure protection.
 - .2 Discharge gas thermistor – to monitor and protect against compressor overheating.
 - .3 Power source fuse capacitor – to safeguard electrical components from surges and faults.
- .7 The unit shall provide continuous ambient operation - no hard cut-off.
- .3 Piping
 - .1 The unit shall be properly installed with mechanical flared fittings.
 - .2 The system shall be capable of operation within the maximum refrigerant piping lengths as published in the manufacturer's performance tables.
 - .3 The unit shall support operation with the maximum vertical separation (height difference) between indoor and outdoor units, as specified by the manufacturer.
 - .4 All refrigerant lines between the outdoor and indoor units shall be field-installed and individually insulated to prevent energy loss and condensation.
 - .5 The stop valve shall be built with 4-directional outlet piping for easier pipe installation. The refrigerant pipes can connect the stop valves from the front and right, rear and bottom of the unit.
- .4 Fan
 - .1 The unit shall be equipped with direct drive propeller fan(s) for energy-efficiency and quiet operation.
 - .2 A steel wire air outlet fan guard grill shall be provided to ensure personnel safety and prevent contact with moving parts while still allowing for maximum airflow.
 - .3 The fan shall be configured for horizontal discharge airflow, drawing air from the rear of the unit and discharging it through the front, with the fan located in front of the condensing coil.
- .5 Coil
 - .1 A condensate base pan with built in heater and a drain connection shall be located beneath the coil to manage water runoff during defrost cycles.
 - .2 The outdoor coil shall be constructed using a multi-pass cross-finned tube configuration, with aluminum fins and copper tubing.
 - .3 The coil shall be protected by a pre-coated metal guard to prevent physical damage and extend service life.
- .6 Sound
 - .1 The unit shall operate with sound pressure levels as low as 49 dB(A) under optimal conditions, ensuring quiet performance suitable for residential and light commercial applications.
- .7 Compressor
 - .1 Each unit shall include a digitally controlled, inverter-driven rotary, and best in class R32 compressor.

- .2 The compressor shall modulate its speed to match the exact room load conditions, improving energy efficiency and reducing operating costs while improving service life of the compressor.
- .3 The compressor shall be factory-mounted with rubber grommets to minimize vibration transmission and ensure long-term reliability.
- .4 The compressor shall feature low torque fluctuation, low vibration, and a wide rotational speed range.
- .5 Compressor capacity shall be automatically modulated by varying refrigerant flow to meet real-time heating or cooling demands.
- .8 Refrigerant
 - .1 The unit shall be factory-charged with R-32 refrigerant.
 - .2 The unit shall be factory charged for up to 99 ft of pipe run, but field charging may be required depending on the installed piping length and elevation, in accordance with manufacturer guidelines.
- .9 Electrical
 - .1 The unit shall operate on a 208/230V, single-phase, 60 Hz power supply.
 - .2 Recommended cable between outdoor and indoor 14AWG - 18AWG 4 conductors stranded copper wire and power wiring cable size must comply with applicable national and local codes.

2.5 INDOOR UNIT – WALL MOUNTED

- .1 General
 - .1 The unit shall communicate with the outdoor unit via 24VDC control wiring.
 - .2 The unit shall be mounted using a wall bracket, which shall be supplied with the unit.
 - .3 The unit shall be factory assembled, piped, wired, and run-tested prior to shipment.
 - .4 The unit and refrigerant piping shall be pre-charged with dehydrated air (nitrogen) at the factory.
 - .5 A wireless remote controller shall be included with the unit.
 - .6 The unit shall include a self-diagnostics function for service and maintenance.
 - .7 The unit shall be designed for use with R-32 refrigerant.
 - .8 The unit and refrigerant pipes shall be charged with nitrogen prior to shipment.
 - .9 The unit shall include a 24-hour timer for automatic on/off scheduling.
 - .10 The unit shall include an emergency button to start/stop operation and reset the filter indicator.
 - .11 The system shall include control board I/Os on indoor and outdoor units to support flexible application control.
- .2 Performance
 - .1 System performance shall be rated in accordance with AHRI 210/240-2023 test conditions for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
 - .2 The unit shall boost heating or cooling for 30 minutes with automatic airflow adjustment.
- .3 Unit Cabinet
 - .1 The unit shall be mounted to a separate back plate, which shall be included with the unit.
 - .2 The front panel shall be removable for access to wiring and internal components.

- .3 The unit shall support multi-directional refrigerant piping.
- .4 The unit shall support multi-directional drain piping.
- .5 The cabinet shall include an integrated infrared sensor to receive commands from the wireless remote controller.
- .6 The unit shall include the following factory-installed safety and control features:
 - .1 Control circuit fuse capacitor.
 - .2 Freeze protection thermostat.
 - .3 Thermostat differential control.
- .4 Fan
 - .1 The unit shall be equipped with a brushless DC fan motor.
 - .2 The fan shall support multiple speed settings.
 - .3 A turbo mode shall be available for rapid cooling or heating.
 - .4 The fan assembly shall include a cross-flow fan with skewed blades, direct-driven by a single motor.
 - .5 A motorized air louver shall be provided with both static position selection and automatic swing in the up/down direction.
 - .6 Side-to-side airflow control shall be standard via an integrated air guide.
 - .7 The unit shall include a low-noise fan design for smooth, quiet airflow.
- .5 Coil
 - .1 The indoor coil shall consist of stamped aluminum louvered fins on copper tubing for enhanced heat transfer.
 - .2 Coil fins shall be treated with a corrosion-resistant coating.
 - .3 All refrigerant lines shall be field-installed and individually insulated.
 - .4 A non-metallic condensate drain pan with factory-installed drain connections shall be located beneath the coil.
- .6 Filter
 - .1 Return air shall be filtered using a factory-supplied, removable, washable filter screen.
- .7 Sound
 - .1 The unit shall operate with a maximum sound pressure level of 47 dB(A) at the highest fan speed.
- .8 Electrical
 - .1 The unit shall operate on 208–230V, 1-phase, 60 Hz power.
- .9 Controls
 - .1 The unit shall be supplied with a wireless handheld controller.
 - .2 The indoor circuit board shall process and receive sensor data, including coil temperature, return air temperature, and setpoint commands from the remote control to effectively communicate demand to the outdoor unit for proper load control.
 - .3 Units shall have wired remote control allowing for provide on/off control, temperature setpoint adjustment, louver controls, fan speed selections, mode settings, function settings, and service settings.
 - .4 Controllers shall include multiple language support.

- .5 The unit shall allow the indoor coil to eliminate up to 99% of bacteria, virus, mold, and other contaminants.
- .6 The unit shall be able to be monitored and controlled remotely from any location.
- .7 The unit shall include auxiliary heater setting for baseboard heating control.
- .8 The system shall have a communication protocol and network compatible for both indoor and outdoor units, with no adapter required for integration into centralized control networks.
- .9 Controllers shall include Celsius or Fahrenheit settings.

2.6 INDOOR UNIT – 4-WAY CASSETTE

.1 General

- .1 The unit shall be a 4-way cassette type, designed for recessed ceiling installation with a decorative ceiling panel and 4-way air distribution.
- .2 The unit shall be factory assembled, piped, wired, and run-tested prior to shipment.
- .3 The unit and refrigerant piping shall be pre-charged with dehydrated air (nitrogen) at the factory.
- .4 A built-in condensate pump with a 33.5-inch lift shall be included for effective drainage.
- .5 The unit shall feature an automatic swing louver for uniform air distribution.
- .6 The unit shall feature an individual 4 louver control.
- .7 The unit shall support infrared remote-control operation.
- .8 A wireless remote controller or wired remote controller shall be used with the indoor unit.
- .9 Panels shall include basic, silent-iconic, and motion sensor style.
- .10 Using a compatible controller and motion sensor kit, the system shall support direct or indirect airflow modes. In indirect mode, airflow is automatically directed away from occupants for enhanced comfort.
- .11 The system shall prevent overcooling at floor level by adjusting airflow and cooling capacity, maintaining comfort above knee height in cooling mode.
- .12 The system shall include control board I/Os on indoor and outdoor units to support flexible application control.

.2 Unit Cabinet

- .1 The cabinet shall be compact and space-saving, suitable for recessed ceiling installation.
- .2 The unit shall have an opening to use with duct adapter for outdoor air applications.
- .3 The 4-way cassette shall have a rectangular cutout for ducting supply air to smaller rooms.
- .4 The 4-way cassette shall have a shutter plate to redirect airflow if needed.
- .5 The 4-way airflow panel shall be mounted to the bottom of the unit.
- .6 The cassette unit shall include the following factory-installed safety and control features:
 - .1 Control circuit fuse capacitor.
 - .2 Freeze protection thermostat.
 - .3 Thermostat differential control.

.3 Fan

- .1 The unit shall be equipped with a brushless DC fan motor for efficient and quiet operation.
 - .2 The DC fan motor shall be drip-proof type enclosure.
 - .3 The DC fan motor shall be rated with insulation Class E
 - .4 The fan shall support up to 4 speed settings to accommodate varying load conditions.
- .4 Coil
 - .1 The indoor coil shall consist of stamped aluminum louvered fins on copper tubing for enhanced heat transfer.
 - .2 Coil fins shall be treated with a corrosion-resistant coating.
 - .3 All refrigerant lines shall be field-installed and individually insulated.
 - .4 A non-metallic condensate drain pan with factory-installed drain connections shall be located beneath the coil.
- .5 Filter
 - .1 The unit shall include a washable air filter made of anti-mold polypropylene or stainless steel.
- .6 Sound
 - .1 The unit shall operate with sound pressure levels ranging from 33 dB(A) to 49 dB(A), depending on fan speed and operating conditions.
- .7 Electrical
 - .1 The unit shall be 208-230V, 1 phase, 60 Hertz separate from the outdoor unit.
- .8 Controls
 - .1 The unit shall have a remote control to provide on/off control, temperature setpoint adjustment, and fan speed selection.
 - .2 The remote controller shall require an infrared sensor to be mounted on the indoor unit
 - .3 The indoor circuit board shall process and receive sensor data, including coil temperature, return air temperature, and setpoint commands from the remote control to effectively communicate demand to the outdoor unit for proper load control.
 - .4 The unit shall have wired remote control allowing for provide on/off control, temperature setpoint adjustment, louver controls, fan speed selections, mode settings, function settings, and service settings.
 - .5 Controllers shall include multiple language support.
 - .6 Units shall allow the indoor coil to eliminate up to 99% of bacteria, virus, mold, and other contaminants.
 - .7 The unit shall be able to be monitored and controlled remotely from any location.
 - .8 The unit shall include auxiliary heater setting for baseboard heating control.
 - .9 The system shall have a communication protocol and network compatible for both indoor and outdoor units, with no adapter required for integration into centralized control networks.
 - .10 Controllers shall include Celsius or Fahrenheit settings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 Ensure adequate clearance for servicing and maintenance.

END OF SECTION

Part 1 General

1.1 SCOPE

- .1 The work covered under this section shall include, but not limited to, the following: (see drawings and specifications for details):
 - .1 Complete a variable refrigerant flow (VRF) system including equipment, piping, and controls.
 - .2 The VRF piping system shall be designed by a manufacturer's certified designer.
 - .3 The VRF piping system shall be installed by a manufacturer's certified contractor.
 - .4 The installing contractor shall be trained and certified at the manufacturer's training facility prior to installation, start-up, and commissioning. Submit for review the installation contractor's certification from the manufacturer. This certification shall include the company certification as well as individual certifications for each contractor which will be working on this project.
 - .5 The refrigeration piping system shall be supplied, installed, tested, evacuated, and charged.

1.2 SYSTEM DESCRIPTION

- .1 The VRF system shall be a direct expansion (DX), three-pipe, heat recovery system.
- .2 The outdoor unit shall consist of one or more frames (modules) connected through common refrigerant piping and control communication wiring.
- .3 The system shall have single or multiple, inverter compressor(s).
- .4 The system shall be connected to multiple indoor units (ducted, non-ducted or mixed combinations) through a common refrigerant piping network and integrated system controls and communication network.
- .5 The system shall operate in either the heating or cooling mode and shall support simultaneous heating and cooling mode.
- .6 The outdoor unit shall be an air cooled unit with vertical discharge that uses refrigerant R32.
- .7 All zones shall be each capable of operating separately with individual temperature control.
- .8 The outdoor unit shall be interconnected to indoor units in accordance with manufacturer's engineering manual detailing each available indoor unit.
- .9 The indoor units shall be connected to the outdoor unit utilizing manufacturer specified piping joints and headers to ensure correct refrigerant flow and balancing.
- .10 The change-over boxes shall control the operational mode of the subordinate indoor units.
- .11 The sum of connected capacity of all indoor units shall range from 55% to 150% of outdoor rated capacity. Up to 150% shall be possible without any factory approval for all capacities.
- .12 Heating defrost operation: The system shall have the ability to use a continuous heating defrost operation for multi-module system configurations.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and shall bear the listed mark.
- .2 All wiring shall be in accordance with the National Electric Code (NEC). The System shall be rated in accordance with Air Conditioning Refrigeration Institute (AHRI) Standard 1230 and bear the AHRI label.
- .3 The system shall be manufactured in an ISO 9001 and ISO 14001 facility, in accordance with the standards set by the International Standard Organization (ISO).
- .4 The units shall meet or exceed ASHRAE 90.1 efficiency requirements for VRF systems.
- .5 Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230 and ISO Standard 13256-1.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Units shall be stored and handled according to the manufacturer's recommendation.
- .2 Units shall be kept clean and isolated from dust and debris.
- .3 Inspect all equipment upon delivery and notify shipping company and manufacturer immediately of any damage.

1.6 WARRANTY

- .1 The parts of a qualified system, including the compressor, shall be warranted for a period (the Standard Part Warranty Period) ending on the earlier to occur of one (1) year after the date of original installation, or eighteen (18) months from the date of manufacture.
- .2 The compressor shall be warranted for an additional six (6) year period after the end of the applicable Standard Part Warranty Period.

Part 2 Products

2.1 REFRIGERANT PIPING

- .1 All refrigerant piping shall be installed in accordance with manufacturer's recommendations.
- .2 No additional sight glasses or filter/dryers shall be required.
- .3 All field installed refrigerant piping shall be nitrogenized ACR copper tubing and shall meet ASTM B280.
- .4 All branch piping joints shall be approved by the manufacturer.

2.2 GENERAL FEATURES

- .1 The air-conditioning system shall use R32 refrigerant.

- .2 The system shall be capable of an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed into the system.
- .3 Each system shall consist of one, two, or three air source outdoor unit modules conjoined together in the field to result in the capacity specified.
- .4 Multiple frame configurations shall be field piped together using manufacturer-designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
- .5 Refrigerant circuit configuration
 - .1 The refrigerant circuit shall be constructed using field provided ACR copper, dehydrated, and piped together with manufacturer supplied Y- branches or headers connected to multiple indoor units to effectively and efficiently control heating or cooling operation of the VRF system.
 - .2 Other pipe materials shall not be allowed.
- .6 Each refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. In no case shall the insulation be allowed to be compressed at any point in the system.
- .7 The outdoor unit will be factory charged with R32.
- .8 Depending on the size and length of the piping when installed, it may require additional trim charging in the field.
- .9 The outdoor unit shall include a refrigerant charge volume analyzer that includes an automatic refrigerant assessment system to check whether or not the correct amount of refrigerant charge exists in a given refrigerant cycle.

2.3 ELECTRICAL

- .1 The outdoor unit power supply shall be 208/230V, 3 phase, 60 Hertz.
- .2 The control circuit between the outdoor unit, changeover boxes, and indoor units shall use AWG18-2 type control wire.

2.4 SAFETY

- .1 The outdoor unit shall include protection devices including a high pressure switch at 4.15 MPa (601psi), over current protection for the inverter and for the printed circuit board (PCB) and overheat protection for the inverter and the compressor.

2.5 ENERGY SAVINGS

- .1 The system shall be equipped with power demand limiting control possibility which prevents excessive energy consumption during peak operating conditions, automatically detects electric current flow and prevents the system from using too much energy.

2.6 CHANGE-OVER BOXES

- .1 The change-over boxes shall be factory assembled, wired, piped and run tested at the factory.
- .2 Multiple indoor units may be connected to a port provided they are within the capacity range of the port.

- .3 The change-over boxes shall be furnished with electronic expansion valves to control the direction of refrigerant flow in each branch. Use of solenoid valves shall not be acceptable due to noise.
- .4 The change-over boxes shall not require provisions for condensate removal.

2.7 INDOOR UNITS – 4-WAY CASSETTE

- .1 General
 - .1 The unit shall have the ability to be recessed into the ceiling with a ceiling grill and shall be a 4-way air distribution type.
 - .2 The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.
 - .3 The unit and refrigerant pipes shall be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.
 - .4 The unit shall be equipped with an electronic expansion valve.
 - .5 The unit shall be equipped with a built-in condensate pump with 33.5” lift.
 - .6 The unit shall have an automatic louver control.
 - .7 The unit shall be available with optional energy saving motion and radiant heat sensor for optimized airflow and temperature control.
- .2 Unit Cabinet
 - .1 The unit cabinet shall be space saving and have the ability to be recessed into a ceiling.
 - .2 The 4-way panel shall be affixed to the bottom of the unit allowing for 4-way airflow.
 - .3 An outside air knockout shall exist for branch ducting supply air.
- .3 Fan
 - .1 The unit shall be equipped with a brushless DC fan motor drive.
 - .2 The unit shall consist of four fan speeds including: low, medium, high, and high 2.
- .4 Filter
 - .1 The standard 1” air filter shall be of a washable type.
- .5 Refrigerant Detection Sensor
 - .1 The unit shall be equipped with a refrigerant detection sensor.
- .6 Sound
 - .1 The sound pressure shall range 27 dB (A) to 37 dB (A) at low speed.
- .7 Electrical
 - .1 The unit shall be 208-230V, 1 phase, 60 Hertz.
 - .2 The control circuit between the units in the system shall use AWG18-2 type control wire.

2.8 INDOOR UNITS – WALL MOUNT

- .1 General
 - .1 The unit shall be factory assembled, piped, and wired, as well as run tested at the factory.
 - .2 The unit and refrigerant pipes shall be charged with dehydrated air (nitrogen gas) prior to shipment from the factory.

- .3 The unit shall have an automatic wide angle louver control.
- .4 The unit shall have a removable front panel for easy cleaning.
- .5 The unit shall have an auto-swing function to ensure efficient air distribution and uniform temperature.
- .6 The unit shall have a built-in wireless sensor.
- .2 Unit Cabinet
 - .1 The unit shall be affixed to a separate galvanized steel back plate to secure the unit firmly to the wall.
- .3 Fan
 - .1 The unit shall be equipped with a brushless DC fan motor drive.
 - .2 The unit shall consist of four fan speeds including: low, medium, high, and high 2.
- .4 Filter
 - .1 The standard 1" air filter shall be of a washable type.
- .5 Refrigerant Detection Sensor
 - .1 The unit shall be equipped with a refrigerant detection sensor.
- .6 Sound
 - .1 The sound pressure shall range 30 dB (A) to 41 dB (A) at low speed.
- .7 Electrical
 - .1 The unit shall be 208-230V, 1 phase, 60 Hertz.
 - .2 The control circuit between the units in the system shall use AWG18-2 type control wire.
- .8 Piping
 - .1 Refrigerant and drain piping shall have the ability to be connected at the right, left or rear of the unit for ease of installation.

2.9 CONTROLS

- .1 Thermostats
 - .1 Wall mounted.
 - .2 Backlit display.
 - .3 Built-in thermistor.
 - .4 Controls temperature, mode, fan speed, and up to 16 indoor units.
 - .5 Seven-day timer with multiple setpoints.
 - .6 Built-in 23-hour timer.
 - .7 Room name and service company name programmable.
 - .8 Help menus and error code diagnosis.
 - .9 Large LCD display shall permit users to see the operating conditions and settings.
 - .10 The timer shall be set at half-hour intervals.
 - .11 Monitor the operating conditions in the system, and an alarm shall be issued if a problem occurs.

- .12 A self-diagnosis function shall check for problems on printed boards in indoor and outdoor units.
- .2 Centralized Controller
 - .1 The centralized controller shall have BACnet/IP integration.

Part 3 Execution

3.1 INSTALLATION

- .1 Install outdoor unit on a flat surface level within 1/8 inch, and elevated a minimum of 18" from roof surface. Provide intermediate supports as recommended by the equipment manufacturer.
- .2 Provide all necessary control wiring as recommended by the manufacturer.
- .3 High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.
- .4 Contact the manufacturer's representative prior to installation to review and confirm piping layout and lengths.
- .5 Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.
- .6 Design and install all piping as per TSSA and CSA B52 regulations, and apply and obtain TSSA certification for all systems.

3.2 COORDINATION

- .1 Coordinate with the EMCS Contractor and manufacturer to ensure the required controls that are show on Drawing 450 and indicated in Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequences of Operations are implemented.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with DCC Representative that Design Criteria and Design Intent are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process.

- .2 Final Report: submit report to DCC Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor.
 - .3 Report format to be approved by DCC Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to DCC Representative in accordance with Section 01 78 00 – Closeout Submittals.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of DCC Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals and Section 25 05 03 – EMCS: Project Record Documents.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 – General Commissioning Requirements.
- .2 Carry out commissioning under direction of DCC Representative and in presence of DCC Representative.
- .3 Inform, and obtain approval from, DCC Representative in writing at least 14 working days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of DCC Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by DCC Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 REQUIREMENTS

- .1 The EMCS Contractor shall ensure that all related work is coordinated among all specification sections, as well as between all divisions, and that the tender price includes all related work.

3.2 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by DCC Representative.
- .3 Commission integrated systems using procedures prescribed by DCC Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.3 SITE QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of site tests of equipment just before installation.
 - .2 Testing may be on site or at Contractor's premises as approved by DCC Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP switches used for dirty filter indication and fan status.

- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp metre at source and to BECC.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 DCC Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
- .9 Transmitters above 0.5% error will be rejected.
- .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and DCC Representative. This document will be used in final startup testing.
 - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of DCC Representative and provide:
 - .1 Two (2) technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 DCC Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and DCC Representative.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.

- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 10 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 5 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 - .6 Correct defects when they occur and before resuming tests.
- .5 DCC Representative to verify reported results.
- .6 Provide 100% point to point verification.

3.4 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by DCC Representative, set and lock devices in final position and permanently mark settings.

3.5 DEMONSTRATION

- .1 Demonstrate to DCC Representative operation of systems including sequence of operations, start-up and shut-down interlocks and lock-outs in accordance with Section 01 79 00 – Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 RELATED REQUIREMENTS

- .1 Section 25 05 01 – EMCS: General Requirements.

1.3 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to DCC Representative 10 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show coordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.5 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 DCC Representative reserves right to approve instructors.

1.6 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.7 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.8 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.9 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2-day program to begin before 20-day test period at time mutually agreeable to Contractor and DCC Representative.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 20 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 5-day program to begin 30 days after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - .2 Equipment maintenance training: provide personnel with 2-day training within a 5-day period in maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .3 Programmers: provide personnel with 2-day training within a 5-day period in following subjects in approximate percentages of total course shown:
 - .1 Software and architecture: 10%
 - .2 Application programs: 15%
 - .3 Controller programming: 50%
 - .4 Trouble shooting and debugging: 10%
 - .5 Colour graphic generation: 15%

1.10 MONITORING OF TRAINING

- .1 DCC Representative to monitor training program and may modify schedule and content.

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 General requirements for building Energy Monitoring and Control System (EMCS) that are common to Division 25 Sections.

1.2 RELATED REQUIREMENTS

- .1 Section 09 91 99 – Painting.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .9 Transport Canada (TC).

- .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

- .1 AEL - Average Effectiveness Level.
- .2 AI - Analog Input.
- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.

- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.5 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be short forms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of short form or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.

1.6 SYSTEM DESCRIPTION

- .1 Refer to control schematics, sequences of operation and related divisions for system architecture.

- .2 Work covered by sections referred to above consists of new fully operational EMCS, including, but not limited to, the following:
 - .1 Building controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS.
 - .4 Data communications equipment necessary to affect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Software/hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by DCC Representative prior to installation.
 - .3 Location of controllers as reviewed by DCC Representative prior to installation.
 - .4 Provide utility power to EMCS.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
 - .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
 - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high-level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions and field-related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS. Point name expansions in English.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within ten (10) workdays after award of contract.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 – EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by the DCC Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .6 Permits and fees: in accordance with general conditions of contract.
 - .7 Submit certificate of acceptance from authority having jurisdiction to DCC Representative.

1.8 QUALITY ASSURANCE

- .1 Have a local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations following tender award showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide seven (7) year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
 - .1 Do construction in accordance with occupational health and safety.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide DCC Representative with schedule within two (2) weeks after award of Contract.

.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 - Cleaning & Waste Management and 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 paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
- .7 Label location of salvaged material's storage areas and provide barriers and security devices.
- .8 Ensure emptied containers are sealed and stored safely.
- .9 Divert unused metal materials from landfill to metal recycling facility.
- .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 BUILDING AUTOMATION SYSTEM

- .1 The building does not presently have a building automation system (BAS).
- .2 A new fully integrated BACnet/IP BAS shall be built in this project.

2.2 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 and ASHRAE STD 135.
- .2 Complete lists of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.3 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Installation shall be to manufacturer's recommendations.
- .2 Provide printed copies of recommendations with shop drawings or product data.

3.2 REQUIREMENTS

- .1 The EMCS Contractor shall review all the documents issued for this project and coordinate with equipment suppliers and Division 23 to ensure that the required control functions will be implemented properly and completely.

3.3 PAINTING

- .1 Painting: in accordance with Section 09 91 99 - Painting, supplemented as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
 - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).
- .2 Related Requirements:
 - .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .2 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).
 - .11 Response time for each type of command and report.
 - .12 Item-by-item statement of compliance.
 - .13 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol, BACnet.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures, and coordinate with requirements in this section.
- .2 Submit preliminary design document within five (5) working days after bid closing and before contract award, for review by DCC Representative.
- .3 Shop drawings shall consist of one (1) soft copy of design documents, shop drawings, product data and software.

- .4 Soft copy to be in AutoCAD - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 15 working days of award of contract and include the following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, and other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .7 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

1.6 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 30 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Complete Point Name Lists.
 - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .6 Software and programming details associated with each point.
 - .7 Manufacturer's recommended installation instructions and procedures.
 - .8 Input and output signal levels.
 - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

- .7 Graphic system schematic displays of air systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 20 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
 - .3 Review interface requirements of materials supplied by others.
 - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 DCC Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to DCC Representative.

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 and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Requirements:
 - .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 05 02 - EMCS: Submittals and Review Process.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 – Closeout Procedures, supplemented and modified by requirements of this section.
- .2 Submit Record Documents, As-built drawings and Operation and Maintenance Manual to DCC Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide one (1) electronic copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit and wiring associated with EMCS installation.

- .4 Locations of obscure devices to be indicated on drawings.
- .5 Listing of alarm messages.
- .6 Panel/circuit breaker number for sources of normal/emergency power.
- .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by DCC Representative.
- .3 Provide before acceptance four (4) hard and one (1) soft copy incorporating changes made during final review.

1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide two (2) complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator

need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

- .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
- .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

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CFB Kingston, ON
Construct New Workshop

EMCS PROJECT RECORD
DOCUMENTS

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END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Requirements and procedures for identification of devices, sensors, wiring, tubing, conduits, and equipment related to integrated automation.
 - .2 Nameplate materials, colours, and lettering sizes to use for identification.
 - .3 Identification of other building systems and components interfacing with, or under control of integrated automation systems.

1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.1-18, Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 26 05 00 - Common Work Results for Electrical for equipment identification, nameplates and labels, wiring identification, conduit and cable identification, and finishes.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Wording List: Proposed wording for nameplates and identification tags.
- .3 Colour-Coding: Proposed scheme for colour-coding conduits and wiring.

Part 2 Products

2.1 DESCRIPTION

- .1 Provide identification for items related to integrated automation in English.

2.2 NAMEPLATES FOR PANELS

- .1 Identify by plastic laminate, 3mm thick melamine, matte white finish, black core, square corners, lettering accurately aligned and engraved into core.

- .2 Sizes: Minimum 25mm x 67mm.
- .3 Lettering: Minimum 7mm high, black.
- .4 Inscriptions: Machine engraved to identify function.

2.3 INPUT/OUTPUT (I/O) SCHEDULES FOR PANELS

- .1 Provide a printed I/O Schedule for each panel containing automation controllers and system I/O. Enclose in a clear plastic envelope hung inside the panel door.
 - .1 I/O Schedule: Include panel name, controller name, legend, I/O point name, I/O point description, I/O point address on controller, description of field device connected to I/O point and the Schedule's revision date.

2.4 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain.
- .2 Sizes: Minimum 50mm x 100mm.
- .3 Lettering: Minimum 5mm high, produced from laser printer in black.
- .4 Data: Include point name and point address.
- .5 Field Devices Inside Panels: Identify by pre-printed self-adhesive vinyl labels using point name.

2.5 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by pre-printed self-adhesive vinyl labels using point name.
- .2 Neatly cut and affix labels on room sensor.
- .3 Location: As directed by the DCC Representative.
- .4 Adjust letter size for legibility.

2.6 LOCATION INDICATORS FOR FIELD PANELS

- .1 Identify locations of field panels installed in concealed spaces (for example, in ceiling spaces, behind access panels, etc.) with orange coloured self-adhering labels, 25mm x 25mm size. Include panel name in legible lettering.

2.7 WARNING SIGNS

- .1 Equipment Including Motors, Starters Under Remote Automatic Control: Supply and install orange coloured signs warning of automatic starting under control of the building automation system (BAS).
- .2 Sign to read, "Caution: This equipment is under automatic remote control of BAS" as reviewed by DCC Representative.

2.8 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets, and outlet boxes.
- .2 Colour Coding: To CSA C22.1, in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Power Wiring: Identify circuit breaker panel / circuit breaker number inside each panel.
- .4 Wiring for Controls and Automation Systems:
 - .1 Identify wiring end-to-end with indelible numbered markings or pre-printed labels.
 - .2 Use distinctive colour-coded cable jackets to identify different types of cabling used throughout system.
 - .1 Wiring for field devices (I/O wiring): Grey cable jacket.
 - .2 Wiring for automation networks: Orange cable jacket.
- .5 Label all manual switches, unless they come with standard nameplates, with engraved plastic laminate nameplates to clearly indicate the service. Wording on nameplates to be subject to acceptance of DCC Representative.

2.9 CONDUIT

- .1 Colour code conduits related to integrated automation.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: Use fluorescent orange paint and confirm colour with DCC Representative during submittal review.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

- .1 Verify manufacturer's nameplates, CSA labels, and identification nameplates are visible and legible at all times.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C2-2012, National Electrical Safety Code.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
- .3 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code.
 - .2 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
 - .5 CSA C22.3 No. 1-15, Overhead Systems.
 - .6 CSA C22.3 No. 7-15, Underground Systems.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 70-2017, National Electrical Code.

1.2 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
 - .2 Hard wiring between field control devices and EMCS field panels.
 - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
 - .4 All wiring shall be in conduit.
- .2 Mechanical:
 - .1 Installation of dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.

1.3 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

1.4 EXISTING CONDITIONS

- .1 Repair all surfaces damaged during execution of work.

- .2 Turn over to DCC Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 PIPING

- .1 Sleeves, escutcheons: refer to Section 23 05 15 – Common Installation Requirements for HVAC Pipework.
- .2 Hangers and supports: refer to Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .3 Insulation: refer to Section 23 07 19 – HVAC Piping Insulation.

2.2 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

2.3 WIRING

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 70 V use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: 18 AWG stranded twisted pair.
 - .4 Analog input and output: shielded #20 minimum stranded twisted pair. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.4 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.

- .3 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
 - .1 Couplings and fittings: threaded type steel.
 - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
 - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.5 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.
- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R.
 - .2 Single: CSA type 5-15R.
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.6 STARTERS, CONTROL DEVICES

- .1 Across-the-line magnetic starters:
 - .1 Enclosures: CSA Type 1, except where otherwise specified.
 - .2 Size, type and rating: to suit motors.
- .2 Starter diagrams:
 - .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .3 Auxiliary Control Devices:
 - .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
 - .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts.

- .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
- .4 Double voltage relays: with barrier to separate relay contacts from operating magnet.
Operating coil voltage and contact rating.
- .4 Finish for starters:
 - .1 Exterior: in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .2 Interior: white.

2.7 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

3.2 PIPING

- .1 Insulation: refer to Section 23 07 19 – HVAC Piping Insulation.

3.3 SUPPORTS

- .1 Install special supports as required.

3.4 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 NFPA 70.
 - .4 ANSI C2.

- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CSA C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.5 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from DCC Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.

- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from DCC Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of DCC Representative's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:
 - .1 Install in inconspicuous but accessible locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
 - .4 Provide correct size of openings. Reducing washers not permitted.
 - .5 Mark location of pull boxes on record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install terminal blocks or strips.
- .17 Install bonding conductor for 120 volt and above in conduit.

3.6 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide DCC Representative with test results showing locations, circuits, results of tests.

- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.7 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
 - .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.8 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.9 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.10 TESTS

.1 General:

- .1 Perform following tests in addition to tests specified Section 25 08 20 – EMCS: Warranty and Maintenance.
- .2 Give 14 working days written notice of intention to test.
- .3 Conduct in presence of DCC Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to DCC Representative in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of DCC Representative and authority having jurisdiction.

3.11 IDENTIFICATION

- .1 Refer to Section 25 05 53 - Identification for Integrated Automation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .2 Related Requirements:
 - .1 Section 25 05 01 - EMCS: General Requirements.
- .3 References:
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process.
- .2 Submit detailed preventative maintenance schedule for system components to DCC Representative.
- .3 Submit detailed inspection reports to DCC Representative.
- .4 Submit dated, maintenance task lists to DCC Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.

- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Maintain records and logs of each maintenance task on site.
 - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .3 Submit records to DCC Representative after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to DCC Representative in accordance with Section 01 33 00 – Submittal Procedures "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish DCC Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.

- .1 No system modification, including operating parameters and control settings, to be made without prior written approval of DCC Representative.

1.5 SERVICE CONTRACTS

- .1 Provide in-depth technical expertise and assistance to DCC Representative and Commissioning Agent in preparation and implementation of service contracts and in-house preventive maintenance procedures.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to DCC Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with DCC Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.

- .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
- .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
- .5 Provide mechanical adjustments, and necessary maintenance on printers.
- .6 Run system software diagnostics as required.
- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).
- .2 Related Requirements:
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
 - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
 - .1 IEEE Std 802.3TM-2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
 - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
 - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530, TIA/EIA-569-A and TBITS 6.9.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.

- .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Modems.
 - .3 Network interface cards.
 - .4 Network management hardware and software.
 - .5 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 EMCS-LAN to: BACnet Protocol.
 - .2 High Speed, high performance, local area network over BACnet/IP with MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
 - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
 - .1 Network medium: shielded twisted cable compatible with network protocol to be used within building.
 - .2 Fibre optic cable shall be used between buildings.

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 building automation controllers including:
 - .1 Master Control Unit (MCU).
 - .2 Local Control Unit (LCU).
 - .3 Equipment Control Unit (ECU).
 - .4 Terminal Control Unit (TCU).
 - .2 Related Requirements:
 - .1 Section 25 05 01 - EMCS: General Requirements.
 - .2 Section 25 05 02 - EMCS: Submittals and Review Process.
 - .3 Section 25 05 03 - EMCS: Project Records Documents.
 - .4 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences or Operation.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2023, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.

- .2 Controller quantity, and point contents to be approved by DCC Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
 - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

1.5 DESIGN REQUIREMENTS

- .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, including PID with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25% of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.

- .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA;
 - .2 0 - 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0 - 10 V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0°C to 44°C and 20% to 90% non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by DCC Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.

- .1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

- .1 Basis of design: AS-P master controller.
- .2 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .3 Include high speed communication LAN Port for Peer to Peer communications with OWS and other MCU level devices.
 - .1 MCU must support BACnet.
- .4 MCU local I/O capacity as follows:
 - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
 - .2 LCUs may be added to support system functions.
- .5 Central Processing Unit (CPU).
 - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
 - .2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.
 - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
 - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
 - .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
 - .3
 - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

2.2 LOCAL CONTROL UNIT (LCU)

- .1 LCUs must support BACnet communication and provide access to the entire BACnet network within the building from any LCUs.
- .2 Provide multiple control functions for typical built-up and package HVAC systems, and electrical systems.
- .3 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .4 Points integral to one Building System to be resident on only one controller.
- .5 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
 - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
 - .4 Include power supplies for operation of LCU and associated field equipment.
 - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook Section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

2.4 SOFTWARE

- .1 General:
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
 - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
 - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage:
 - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

- .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages:
 - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by DCC Representative.
- .4 Operator Terminal interface:
 - .1 Operating and control functions include:
 - .1 Multi-level password access protection to allow user/manager to limit workstation control.
 - .2 Alarm management: processing and messages.
 - .3 Operator commands.
 - .4 Reports.
 - .5 Displays.
 - .6 Point identification.
- .5 Pseudo or calculated points:
 - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
 - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
 - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
 - .3 Perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
 - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 Two position control.
 - .2 Proportional Integral and Derivative (PID) control.

- .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will ensure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
 - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
 - .1 Time of day scheduling.
 - .2 Calendar based scheduling.
 - .3 Holiday scheduling.
 - .4 Temporary schedule overrides.
 - .5 Optimal start stop.
 - .6 Night setback control.
 - .7 Enthalpy (economizer) switchover.
 - .8 Peak demand limiting.
 - .9 Temperature compensated load rolling.
 - .10 Fan speed/flow rate control.
 - .11 Night purge.
 - .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
 - .3 Apply programs to equipment and systems as specified or requested by DCC Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
 - .1 MCUs to accumulate and store automatically run-time for binary input and output points.

- .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
- .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
- .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
- .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
- .6 Store event totalization records with minimum of 9,999,999 events before reset.
- .7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

- .1 Location of controllers to be approved by DCC Representative.

3.2 INSTALLATION

- .1 Install controllers in secure locking enclosures as directed by DCC Representative.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 84 00 – Fire Stopping.
- .2 Section 23 33 15 – Dampers – Operating.
- .3 Section 25 01 11 - EMCS: Start Up, Verification and Commissioning.
- .4 Section 25 05 01 - EMCS: General Requirements.
- .5 Section 25 05 02 - EMCS: Submittals and Review Process.
- .6 Section 25 05 53 – Identification for Integrated Automation.
- .7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .8 Section 26 05 00 - Common Work Results - Electrical.
- .9 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by DCC Representative for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

- .1 Repair surfaces damaged during execution of Work.
- .2 Turn over to DCC Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .8 Range: including temperature, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:

- .1 Thermocouples: limit to temperature range of 200 degrees C and over.
- .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
- .2 Duct temperature sensor:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460mm.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
 - .3 Single-point type: sensor probe shall be mounted as close as possible to the center of the duct, both vertically and horizontally, and as far from the electric heater as possible but upstream of the last diffuser tap and at least 0.9 m downstream of the heater.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50degrees C.
 - .10 Long term output drift: not to exceed 0.25% of full scale/ 6 months.
 - .11 Transmitter ranges:
 - .1 Supply air temperature from DOAS-1: 10 to 35°C, plus or minus 0.25°C.

2.4 ELECTROMECHANICAL RELAYS

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 V AC.

- .4 Relay to have visual status indication.

2.5 CURRENT TRANSDUCERS

.1 Requirements:

- .1 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
- .2 Frequency insensitive from 10 - 80 Hz.
- .3 Accuracy to 0.5% full scale.
- .4 Zero and span adjustments. Field adjustable range to suit motor applications.
- .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.6 CURRENT SENSING RELAYS

.1 Requirements:

- .1 Suitable to detect belt loss or motor failure.
- .2 Trip point adjustment, output status LED.
- .3 Split core for easy mounting.
- .4 Induced sensor power.
- .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
- .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
- .7 Adjustable latch level.

2.7 CONTROL DAMPERS

- .1 See Section 23 33 15 – Dampers – Operating.

2.8 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Requirements:

- .1 Direct mount proportional type as indicated.
- .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
- .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
- .4 Power requirements: 5 VA maximum at 24 V AC.
- .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
- .6 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.9 PANELS

- .1 Free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by DCC Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.10 WIRING

- .1 In accordance with Division 26 27 26 – Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded: #20 minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Fire stopping. Maintain the fire-resistance rating integrity of the fire separation.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .2 Refer to control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation and on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by DCC Representative before beginning Work.

- .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .4 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS.
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
- .5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. DCC Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 TEMPERATURE SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .4 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 53 - Identification for Integrated Automation.

3.5 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes:
 - .1 Programming and configuration of site-specific requirements for sequences of operation to meet the Project's operational criteria.
 - .2 Work results directly related to Division 25. Sequences of operation described in this Section solely relate to physical and logical points under control and supervision of the integrated automation system.
 - .1 Third-party systems and packaged equipment with built-in controls are assumed to be provided with preprogrammed routines or configurable operating modes with which the integrated automation system interacts.
 - .2 Achieving a fully functional system compliant with the described sequences of operation extends beyond programming. It may include providing hardwire interlocks, adjusting instrument and control device settings, and modifying configuration parameters in third-party systems or equipment.
 - .3 Work specified in this Section closely relates to equipment and work results specified in other Sections of Division 25. Read this Section in conjunction with:
 - .1 Controls schematic diagrams and control point tables on drawings showing instrumentation and control devices deployed to perform direct control of equipment.
 - .2 Instrumentation and control device requirements in other Sections.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Integrated Systems: Coordinate system interfaces connecting to integrated automation equipment with other Subcontractors, manufacturers, and suppliers to verify compliance with intended sequences of operation.
 - .1 Review submittals of third-party equipment and notify DCC Representative when the proposed interface will affect the intended sequences of operation.
 - .2 Review third-party products and coordinate with trades to resolve integration issues and propose corrections.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit sequences of operation during Shop Drawing review in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Integrated Systems: Submit proposed changes to system interface and sequences of operation to DCC Representative for review.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

.2 Record Documentation:

.1 Submit recorded changes made to sequences of operation during construction and commissioning activities.

.1 Submit a copy of sequences of operation in Microsoft Word format so changes can be made and saved by DCC Representative. Protect files to prevent modifications by unauthorized users.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Programmers: Personnel specialized in configuring and commissioning this type of installation.

.2 Programmers to provide all control stratagems to ensure systems operate in a safe and efficient manner. Include delays, ramps, reset functions, interlocks, and cascade loops.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 SEQUENCING - GENERAL

.1 The EMCS Contractor shall allow for programming each point in the control point tables allowing for programming sequences of operation, alarm points, trend logs, totalizers and energy management routines.

.2 The setpoints and algorithms shall be adjustable by the building operator.

.3 If a controlled parameter is outside its normal operating tolerance from setpoint, the integral and derivative portions of the PID loops shall be disabled to avoid integral windup.

.4 The EMCS Contractor shall coordinate with unit manufacturers and Division 23 to ensure the controls as required in contract documents are implemented.

3.2 SEQUENCING – VARIABLE REFRIGERANT FLOW (VRF) SYSTEM AND ELECTRIC HEATING SYSTEM

.1 General

.1 All occupied spaces as shown on plans will be air-conditioned by a new VRF system, which mainly includes multiple indoor fan coil units (IFC-1.1 thru IFC-1.7), one (1) heat recovery unit and one (1) outdoor unit (OU-1).

.2 The VRF system will provide cooling and dehumidification whenever cooling is called for.

- .3 The VRF system will provide heating whenever heating is called for and ambient temperatures favour.
- .4 Indoor fan coil units shall be controlled via thermostats that are supplied by the VRF manufacturer, can also control electric baseboard heaters and electric cabinet unit heater and can be integrated into the BAS.
- .5 Outdoor unit and heat recovery unit shall operate and modulate in concert with indoor fan coil units to achieve space temperature setpoint via the controllers supplied by the VRF manufacturer.
- .6 BAS shall monitor the status of both outdoor unit and indoor fan coil units.
- .2 Occupied Mode
 - .1 Energize the VRF system on an adjustable time-of-day schedule.
 - .2 Thermostats shall use room temperature to automatically select heating or cooling mode.
 - .3 Cooling Mode (room temperature setpoint = 24°C db (adj))
 - .1 When room temperature rises above cooling setpoint with 1.5°C (adj), Cooling Mode shall be enabled, and heating shall be disabled.
 - .2 Thermostats shall cycle fans (within indoor fan coil units) on/off to maintain the room temperature setpoint.
 - .4 Heating Mode (room temperature setpoint = 21°C db (adj))
 - .1 When room temperature drops below heating setpoint with 1.5°C (adj), Heating Mode shall be enabled, and cooling shall be disabled.
 - .2 Thermostats shall cycle fans (within indoor fan coil units) on/off to maintain the room temperature setpoint.
 - .3 Whenever ambient conditions favour, heat pump shall operate to maintain the room temperature setpoint.
 - .4 When the room temperature setpoint cannot be achieved by heat pump or heat pump cannot operate due to ambient conditions, the electric baseboard heater or electric cabinet unit heater shall be enabled and modulated to maintain the room temperature setpoint.
- .3 Unoccupied Mode
 - .1 Shut down compressors and condenser fans.
 - .2 Activate heating when room temperature drops below 15°C (adj).
 - .1 Thermostats shall cycle fans (within indoor fan coil units) on/off to maintain room temperature @ 15°C (adj).
 - .3 Whenever ambient conditions favour, heat pump shall operate to maintain room temperature @ 15°C (adj).
 - .4 When room temperature cannot be achieved by heat pump or heat pump cannot operate due to ambient conditions, the electric baseboard heater or electric cabinet unit heater shall be enabled and modulated to maintain the room temperature @ 15°C (adj).
 - .3 Deactivate heating when room temperature exceeds 21°C (adj).

3.3 SEQUENCING – DEDICATED OUTDOOR AIR SYSTEM UNIT

- .1 General
 - .1 A dedicated outdoor air system unit (DOAS-1) will deliver pre-heated outdoor air to indoor fan coil units.

.2 Occupied Mode

- .1 BAS shall start the unit based on time-of-day schedule or manual selection via graphic interface.
- .2 Outdoor air damper shall open.
- .3 Supply fan shall operate continuously at a constant speed.
- .4 Electric coil shall be enabled and modulated to maintain supply air temperature setpoint at 21°C (adj).

.3 Unoccupied Mode

- .1 Supply fan shall stop.
- .2 Outdoor air damper shall close.
- .3 Electric coil shall be de-energized.

3.4 SEQUENCING – GENERAL VENTILATION FANS (EF-2 and 4)

.1 General

- .1 Kitchen/lunchroom and washroom shall be ventilated by exhaust fans EF-2 and EF-4 respectively.
- .2 Energize fans based on the time-of-day schedule or manual selection via graphic interface.

.2 Occupied Mode

- .1 Exhaust air dampers shall open.
- .2 Fans shall run continuously at a constant speed.

.3 Unoccupied Mode

- .1 Fans shall stop.
- .2 Exhaust air dampers shall close.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings

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 REFERENCE STANDARDS

- .1 ALL referenced standards shall be the latest editions in effect at the time of tender.
- .2 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 Current Edition, Safety Standard for Electrical Installations.
 - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

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, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams under plexiglass and locate in the new electrical room.
- .4 Shop drawings:
 - .1 Submit engineered drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .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 of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

- .5 Submit ONE copy of 600 x 600 mm minimum size drawings and product data to DCC Representative in Adobe PDF format.
- .6 If changes are required, notify DCC Representative of these changes before they are made.
- .5 Certificates:
 - .1 Provide equipment and material certified to CSA Standards.
 - .2 Where CSA certified equipment or material is not available, submit such equipment and material to the 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 DCC Representative.
- .6 Manufacturer's Field Reports: submit to DCC Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .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 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 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 equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of 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 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.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be certified to CSA Standards. Where CSA certified material or equipment is not available, obtain special approval from the inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of DCC Representative.

- .2 Lamacoid signs, Red coloured with White text, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.
 - .2 Sizes as follows:
NAMEPLATE SIZES:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by DCC Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. (____) " as directed by DCC Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

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 10 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
System 1	Coordinate with DCC/DND	
System 2	Coordinate with DCC/DND	
System 3	Coordinate with DCC/DND	
Fire Alarm	Red	
Emergency	Red	Blue
Other Voice	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 outdoor electrical equipment "equipment green" finish.
- .2 Paint indoor switchgear and distribution enclosures light gray.

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 installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise

- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 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 rooms on latch side of door.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline 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.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 300 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.

- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and interphone outlets: 300 mm.
- .5 Wall mounted telephone and interphone outlets: 1200 mm.

3.7 CO-ORDINATION AND ARC FLASH STUDIES

- .1 Submit co-ordination and arc flash study of electrical protection devices, prepared by low Voltage switchgear manufacturer. The co-ordination study and arc flash study shall be carried out as soon as the electrical contract is awarded and the suppliers of electrical equipment selected so that the electrical subcontractor can ensure that all equipment ordered complies with the requirements established by the co-ordination study and arc flash study. The co-ordination study and arc flash study shall encompass the new electrical service, new service entrance equipment and the new distribution equipment inside the building. The two studies shall be coordinated to provide an integrated report. Electrical contractor is responsible for verifying all equipment quantities, ratings and cable lengths for the studies.
- .2 The co-ordination study shall include at least the following:
 - .1 Comprehensive fault calculations.
 - .2 Verification and selection of protection relays and determining the correct pick-up and time delay, etc., settings.
 - .3 Determine the correct settings and interrupting capacities of all protective devices.
 - .4 Correct selection and settings of motor protection.
 - .5 Determine all fuse types and sizes.
 - .6 Trip curves coordinated with the utility protection elements and each other.
 - .7 Ground fault protection curves, coordinate with each other and downstream protection elements.
 - .8 Damage curves for all equipment and cables, co-ordinate with the pertinent protective devices.
 - .9 Complete single line diagram(s) showing protective device sizes, trip settings, interrupting capacities and system fault levels.
 - .10 Prepare graphic co-ordination curves on log-log time current characteristics sheets. Prepare separate sheets for the various power distribution elements to maintain clarity. Comply also with the utility's specific requirements. Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the pertinent portion of the system.
 - .2 The pertinent protection curves.
 - .3 The pertinent damage curves.
 - .4 The system fault level(s).
 - .5 The selected settings of the protection elements.
 - .6 Ground fault protection curves.
- .3 Co-ordination study to recommend protective device settings and short circuit interrupting capacities which results in greatest degree of selective co-ordination.
- .4 Co-ordination study to be submitted for approval prior to manufacture of major equipment.

- .5 Arc flash hazard analysis shall be provided in accordance with the following:
- .1 The arc flash hazard analysis shall be performed with the aid of a digital computer in order to calculate Arc Flash Incident Energy (AFIE) levels and arc flash protection boundary distances.
 - .2 The arc flash hazard analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.
 - .3 Results of the arc flash hazard analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
 - .4 Circuits less than 100 amperes may be omitted from the computer model and will be assumed to have a hazard risk category 0.
 - .5 The arc flash hazard analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
 - .6 The arc flash hazard analysis shall be performed by a registered professional engineer.
 - .7 The arc flash hazard analysis shall be performed in compliance with IEEE standard 1584-2002, the IEEE guide for performing arc flash calculations.
 - .8 The arc flash hazard analysis shall include recommendations for reducing AFIE levels and enhancing worker safety.
 - .9 The arc flash hazard analysis shall report incident energy values based on the existing incident energy values at all buses within the scope of the study in addition to incident energy values based on the recommended overcurrent device setting changes.
 - .10 The proposed vendor shall have considerable experience performing arc flash hazard analysis studies using software such as ETAP, SKM, Easy Power or similar, in compliance with IEEE 1584 and NFPA 70E standards. Analysis report to indicate incident energy levels at key system busses and detail the required PPE at those locations. Supply and install equipment labels on completion of project.
 - .11 The proposed vendor shall provide equipment labels. The labels shall comply with relevant CSA Standards as well as UL 969 and must include the following information:
 - .1 Equipment name
 - .2 AFIE flash hazard boundary
 - .3 AFIE value (cal/cm²)
 - .4 Hazard risk category
 - .5 System voltage
 - .6 Limited approach boundary
 - .7 Restricted approach boundary
 - .8 Prohibited approach boundary
 - .12 The data fields on the label shall be populated from the results of the arc flash hazard analysis. Where circuits have been omitted from the computer model as permitted by an applicable industry standard a generic label shall be provided.
 - .13 Include AFIE label installation. Apply labels to all panels to ANSI Z535.4 (even if they are exempt under item 14 below.)
 - .14 Single phase AC distribution systems are not included in the scope of the analysis.

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL 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 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 DCC Representative.
- .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 - ACTION AND INFORMATIONAL 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.

3.9 SYSTEM STARTUP

- .1 Instruct DCC Representative 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.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of electrical components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete work described in this Section ready for new construction.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to DCC Representative ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350, Code of Practice for Safety in Demolition of Structures

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:

- .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: The building will be unoccupied during the period of construction.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Ontario Workers' Compensation Boards
 - .2 Ontario Occupational Health and Safety Standards and Programs

1.8 SITE 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.
- .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify DCC Representative if materials suspected of containing hazardous substances are encountered and perform following activities:
 - .1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.
 - .2 Hazardous substances will be as defined in Hazardous Products Act.
 - .3 Stop work in area of suspected hazardous substances.
 - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .5 Hazardous substances will be removed by DCC Representative under a separate contract or as a change to Work.
 - .6 Proceed only after written instructions have been received from DCC Representative.

1.9 SALVAGE AND DEBRIS MATERIALS

- .1 Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain DCC Representative's property.

Part 2 Products

2.1 MATERIALS

- .1 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- .2 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; DCC Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify DCC Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants when building is occupied: Sequence demolition work so that interference with the use of the building by the DCC Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify DCC Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section with information contained in Section 02 41 13 - Selective Site Demolition and as follows:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.

- .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
- .3 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of work, leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- .4 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- .5 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .6 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .7 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .8 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)
 - .1 ICEA S-93-639/NEMA WC74, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data.
 - .1 Submit manufacturer's product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Manufacturers' Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 RUBBER INSULATED CABLES (5001 - 15000 V)

- .1 Single copper conductor: To ICEA S-93-639/NEMA WC74 size as indicated
- .2 Strand shielding.
- .3 Insulation: Chemically cross-linked thermosetting tree resistant polyethylene material rated 90 degrees C and [15] kV.
- .4 Barrier tape over shield.
- .5 Overall jacket of PVC rated minus 40 degrees C.

2.2 CONCENTRIC NEUTRAL POWER CABLES (5001 - 15000 V)

- .1 Concentric neutral power cable: to ICEA S-93-639/NEMA WC74
- .2 Single copper conductor, size as indicated.

- .3 Semi-conducting extruded shield.
- .4 Class 2.
- .5 Insulation: cross-linked thermosetting tree resistant polyethylene material rated 90 degrees C and 15 kV for 100 % voltage level.
- .6 Semi-conducting insulation shielding layer.
- .7 Copper neutral wires applied helically over insulation shield equivalent to 100% full capacity.
- .8 Separator tape over neutral wires.
- .9 Extruded PVC jacket rated minus 40 degrees C.
- .10 An alternative acceptable cable type is 15 kV, EPR tape shield, 133% insulation, type MV-105, to be combined with a 2/0 RW90 green copper ground. Product composition as follows:
 - .1 Conductor: compact round class B stranded copper
 - .2 Conductor screen: Extruded semiconducting (SC-EPR)
 - .3 Insulation: Extruded ethylene propylene rubber
 - .4 Insulation screen: Extruded semiconducting (SC-EPR)
 - .5 Metallic shield: Bare copper tape shield with overlap
 - .6 Outer jacket: Polyvinyl Chloride (PVC)Temperature ratings: 105 deg C continuous; 140 deg C emergency and 250 deg C short circuit.

Part 3 Execution

3.1 INSTALLATION

- .1 Install power cable in ducts, transformer bases and switchgear bases as indicated and in accordance with manufacturer's instructions.
- .2 Install power cable in trenches as indicated.
- .3 Provide supports and accessories for installation of high voltage power cable.
- .4 Install grounding in accordance with local inspection authority having jurisdiction.
- .5 Provide cable identification tags and identify each phase conductor of power cable.

3.2 SITE QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

- .3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.18.1 – Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1)
 - .2 CSA C22.2 NO. 18.2 – Non-metallic outlet boxes
 - .3 CSA C22.2 NO. 18.3 – Conduit, tubing, and cable fittings (Trinational standard with ANCE NMX-J-017 and UL 514B)
 - .4 CSA C22.2 NO. 18.4 – Hardware for the support of conduit, tubing, and cable (Bi-national standard with UL 2239)
 - .5 CAN/CSA-C22.2 NO. 65 – Wire connectors (Trinational standard with NMX-J-543-ANCE and UL 486A-486B)
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

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 wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

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 wire and box connectors for incorporation into manual.

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 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 of 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 alloy 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 alloy 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 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable and flexible conduit 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 DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65

- .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
- .3 Install bushing stud connectors in accordance with NEMA.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 for Electrical
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V)
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

1.2 PRODUCT DATA

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 or 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE, Non Jacketted.

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.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 or 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

- .7 Fastenings:
 - .1 One hole steel 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 at 900 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Type: ACWU90 jacket over armour and compliant to applicable Building Code classification for this project wet locations.
- .5 Connectors: anti short connectors.

2.4 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: PVC.
 - .2 Shielding: braid over each pair.
 - .3 Overall covering: PVC jackets.
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated:
 - .1 Insulation: PVC RW90 (x-link).
 - .2 Shielding: metallized tapes each pair of conductors.
 - .3 Overall covering: thermoplastic jacket.

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 using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.
- .3 Perform 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 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 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 underground ducts in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
 - .3 In wireways and auxiliary gutters in accordance with Section 26 05 37 – Wireways and Auxiliary Gutters.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable concealed where possible, securely supported by straps or hangers.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.

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.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

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 datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals:
 - .1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .2 Plate electrode: copper surface area to suit soil conditions and grounding requirements.
- .3 Conductors: bare, stranded, untinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures and transformers.
- .4 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermite welded type conductor connectors.

- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.
- .5 Wire connectors and terminations: as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Install connectors and Cadweld in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors during and after construction.
- .4 Make buried connections, and connections to electrodes using permanent mechanical connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.2 ELECTRODE INSTALLATION

- .1 Install ground rod electrodes at transformer.
- .2 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 SITE QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

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 grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

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 grounding equipment 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 grounding equipment 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 of 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 EQUIPMENT

- .1 Rod electrodes: galvanized steel, 19 mm diameter by minimum 3 m long.
- .2 Plate electrodes: copper, surface area to suit soil conditions and grounding requirements.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .4 Insulated grounding conductors: green, copper conductors, size as indicated.
- .5 Telecommunications ground bus: pre-drilled copper bus bar, approved by NRTL, electrotin-plated with holes 8mm diameter for use with standard size lugs to: ANSI J-STD-607-A. Dimensions 6mm thick x 100mm wide x 450mm long, complete with insulated supports, fastenings and connectors.
- .6 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 Thermite welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

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 grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Run separate ground wire in conduit, DO NOT USE CONDUIT AS GROUND.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to 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 ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Where outdoor lighting standards are provided, install separate ground conductor.
- .9 Connect building structural steel and metal siding to ground, by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at both load ends.
- .12 Ground secondary service pedestals.

3.3 ELECTRODES

- .1 Install rod or plate electrodes and make grounding connections as indicated.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 3/0 AWG copper conductors for connections to electrodes.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary 120/208V system.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, generating sets, duct systems, control panels and distribution panels.

3.6 GROUNDING BUS

- .1 Install copper grounding bus, wall mounted on insulated supports, in Electrical room, IT room and CAD area.
- .2 Interconnect ground bars using 2/0AWG stranded copper. Ground items of electrical equipment in Electrical room and IT equipment in IT room and CAD area to ground bus with individual stranded copper connections size 2/0AWG, or as noted otherwise.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 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 hangers and supports 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 of 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 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.

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 hangers and supports installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.

- .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 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.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at 3 m on centre spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of DCC Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.

- .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 for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

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 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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 and 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 turned edge covers.

2.3 CABINETS

- .1 Construction: welded sheet steel, hinged door, handle and catch
- .2 Type E Empty: flush overlapping sides mounting as indicated.
- .3 Type T Terminal: flush overlapping sides, mounting as indicated 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 Only main junction and pull boxes 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 or as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1
- .2 103 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 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 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. 103 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 103 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished plaster and tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 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 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.7 COMMUNICATIONS OUTLET BOXES

- .1 Size boxes in accordance with CSA C22.1 and BICSI standard (Building Industry Consulting Service International).
- .2 Double gang, 100 x 100 x 54mm c/w single gang 12.5mm plaster ring/reducer plate.
- .3 Gang boxes where communication wiring devices are grouped.
- .4 Blank cover plates for boxes without communication wiring devices.

Part 3

Part 4 Execution

4.1 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 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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 NO. 18.1 – Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1)
 - .2 CSA C22.2 NO. 18.2 – Nonmetallic outlet boxes
 - .3 CSA C22.2 NO. 18.3 – Conduit, tubing, and cable fittings (Trinational standard with ANCE NMX-J-017 and UL 514B)
 - .4 CSA C22.2 NO. 18.4 – Hardware for the support of conduit, tubing, and cable (Bi-national standard with UL 2239)
 - .5 CSA C22.2 NO. 45.1 – Electrical rigid metal conduit - Steel (Trinational standard with UL 6 and NMX-J-534-ANCE-2007)
 - .6 CSA C22.2 NO. 45.2 – Electrical rigid metal conduit - Aluminum, red brass, and stainless steel (Tri-national standard, with NMX-J-576-ANCE and UL 6A)
 - .7 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .8 CSA C22.2 NO. 83.1 – Electrical Metallic Tubing - Steel (Tri-National Standard, with UL 797 and NMX-J-536-ANCE-2007)
 - .9 CSA C22.2 NO. 18.3 – Conduit, tubing, and cable fittings (Trinational standard with ANCE NMX-J-017 and UL 514B)
 - .10 CSA C22.2 No. 211.2 – Rigid PVC (Unplasticized) Conduit.
 - .11 CAN/CSA C22.2 No. 227.3 – Mechanical protection tubing (MPT) and fittings (Trinational standard with UL 1696 and NMX-J-855-ANCE)

1.2 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.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 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 Reel and mark shielded cables rated 2,001 volts and above.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped 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
- .5 Flexible metal conduit: to CSA C22.2 No. 56, steel, liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 53 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 3 m on centre.
- .4 Threaded rods, 6 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 90 degrees bends for 27 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

2.6 PULL ROPE

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

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 rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .4 Use epoxy coated conduit in corrosive areas.
- .5 Use electrical metallic tubing (EMT) above 2.4 m and not subject to mechanical injury.
- .6 Use rigid PVC conduit underground.
- .7 Use flexible metal conduit for connection to motors in dry areas.
- .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .9 Minimum conduit size for lighting and power circuits: 19 mm.
- .10 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install pull rope in empty conduits.
- .14 Run 2-27 mm spare conduits up to ceiling space and 2-27 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 153 x 153 x 103 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .15 Remove and replace blocked conduit sections.

- .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.
- .17 DO NOT USE CONDUIT AS GROUND. Provide separate ground conductor in each conduit.

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 surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .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.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning & Waste Management.
- .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.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.1 No.126.1-09, Metal Cable Tray Systems (Bi-national standard, with NEMA VE 1-2009).
 - .2 CAN/CSA C22.1 No.126.2-02 (R2007), Non Metallic Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA FG 1, Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1, Metal Cable Tray Systems.
 - .3 NEMA VE 2, Cable Tray Installation Guidelines.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 26 05 00 – Submissions.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Show actual cabletrough installation details and suspension system.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Demolition/Construction Waste Management and Disposal Plan.

Part 1 Products

1.5 CABLETROUGH

- .1 Cabletroughs and fittings: to NEMA and CAN/CSA C22.1 No. 126.1.
- .2 Ladder, Ventilated, Non-Ventilated, **Wire Mesh Basket type**, Class A, C1, D1, E to CAN/CSA C22.2 No.126.1.
- .3 Trays: galvanized steel with width and depth indicated on drawing.

- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
 - .1 Radii on fittings: 300 mm minimum.
- .5 Solid covers or bottoms for complete cabletrough system including fittings, where applicable, as indicated on drawings.
- .6 Barriers where different voltage systems are in same cabletrough.
- .7 Ground cable trays with minimum #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .8 Provide fire stop material at firewall penetrations.
- .9 Barriers and inner duct to be installed in trays to separate electrical wiring and telecommunication cabling. All raceways to workstations and millwork to be supplied with a separate pathway built into raceway for telecommunications.

1.6 SUPPORTS

- .1 Provide splices, supports for a continuously grounded system as required.

Part 2 Execution

1.7 INSTALLATION

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .4 Install cable trays and cables in accordance with OESC sections 12-2200 to 12-2210.
- .5 Provide 300mm vertical clearance from the top of the cable tray to all ceilings, ducts and equipment and 150mm for short length obstructions. Provide 600mm horizontal clearance on one side of cable trays mounted adjacent to one another or to walls or other obstructions, where the width of the cable tray installation does not exceed 1m.

1.8 CABLES IN CABLETROUGH

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 00 - Common Work Results - Electrical.

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- .5 Provide nylon pull cord in empty pathway for telecommunication cabling.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.26 – Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

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 wireways and auxiliary gutters and include product characteristics, performance criteria, physical size, finish and limitations.

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 wireways and auxiliary gutters 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 wireways and auxiliary gutters 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 of 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 WIREWAYS

- .1 Wireways and fittings: to CSA C22.2 No.26
- .2 Sheet steel with hinged cover to give uninterrupted access.
- .3 Finish: baked grey enamel in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

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 wireways and auxiliary gutters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install wireways and auxiliary gutters in accordance with manufacturer's written recommendations.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.
- .6 Ground metallic wireways and gutters as required.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.

- .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 for Electrical
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling,

1.2 REFERENCE STANDARDS

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 cables and include product characteristics, performance criteria, physical size, finish and limitations.

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 cables 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 of 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 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, red with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW ".

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 cable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 DIRECT BURIAL OF CABLES

- .1 After sand bed in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
 - .1 Do not pull cable into trench.
- .2 Include offsets for thermal action and minor earth movements.
 - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Underground cable splices not acceptable.
- .4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .5 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
 - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

3.3 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.

3.4 WARNING TAPE

- .1 Provide warning tape for entire length of trench or duct. Tapes to cover entire width of trench or duct.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include 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.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 100% of original factory test voltage in accordance with manufacturer's recommendations.
- .7 Provide DCC Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.

- .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.

3.7 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies the Contractor's responsibilities related to commissioning of electrical systems and their contribution to the overall commissioning work specified in the relevant Technical Sections of Division 01 of the Contract Documents.
- .2 Construction Team: Contractor is responsible for performing tests and verification activities specified in the relevant Sections of Division 26 of the Contract Documents, and submitting reports to Commissioning Authority.
 - .1 Subcontractors: electrical subcontractors and third-party inspection/testing agencies participate in commissioning activities in coordination with site quality control requirements for Work they are providing.
 - .2 Manufacturers: manufacturers assist verification activities and report on installation, performance and operation of the products/systems they supplied, as specified in the relevant Sections of Division 26.
 - .3 Contractor coordinates the work of subcontractors, inspection/testing agencies and manufacturers with the commissioning requirements of this Section.
- .3 Commissioning Authority (CxA): the CxA may assign a commissioning specialist with expertise in building electrical systems, to undertake its commissioning responsibilities related to this Section.
- .4 DCC Representative will designate a person to represent the interests of the facility related to work specified in the relevant Sections of Division 26.
 - .1 O&M Representative: DCC Representative may designate an additional representative to participate in the commissioning process and facilitate the transfer of electrical systems to the facility's O&M staff.
- .5 The requirements of this Section do not replace testing requirements specified in the relevant Sections of Division 26, or reporting activities to demonstrate compliance with electrical code requirements to the authorities having jurisdiction.

1.2 ACRONYMS

- .1 BMM - Building Management Manual
- .2 CT - Construction Team
- .3 Cx - Commissioning
- .4 CxA - Commissioning Authority
- .5 EMCS - Energy Monitoring and Control Systems
- .6 FPT - Functional Performance Testing

- .7 O&M - Operation and Maintenance

1.3 DEFINITIONS

- .1 Construction Team: the term Construction Team is used in this Section to designate inclusively the Contractor, subcontractors, manufacturers/suppliers and other support disciplines that are responsible for construction/installation of the Work specified in these specifications.
- .2 Cx Forms: forms used to document the inspections, tests and verification activities performed during the commissioning process, as specified in Section 01 91 13 - General Commissioning Requirements.
- .3 Cx Plan: a document developed under the responsibility of the CxA to specify the project's commissioning requirements, as specified in Section 01 91 13 - General Commissioning Requirements.
- .4 Cx Team: the commissioning team consists of project members that participate in the development, refinement and execution of the Cx Plan, as specified in Section 01 91 13 - General Commissioning Requirements.

1.4 REFERENCE STANDARDS

- .1 CSA Group (CSA):
- .1 CSA Z320, Building Commissioning
 - .2 CSA Z5000, Building Commissioning for Energy Using Systems

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Construction Team - Cx Representative: Contractor to designate a person from the Construction Team to review and coordinate commissioning activities specified in this Section.
- .1 Representative to be acceptable to DCC Representative and CxA with the following qualifications:
- .1 Technical personnel with considerable experience in construction, testing and commissioning of electrical systems. Submit CV to DCC Representative for review and acceptance.
 - .2 Site supervisor or project manager within the Construction Team, with direct responsibilities for supervising the execution of work specified in the relevant Sections of Division 26.
- .2 Coordination: coordinate the responsibilities of the Construction Team in the Cx process with the responsibilities of other participants that form part of the Cx Team.
- .1 Coordinate the participation of electrical subcontractors, inspection/testing agencies and manufacturers in reviewing the Cx Plan, submittals and in assisting testing and demonstration activities related to their work.
 - .2 Coordinate commissioning activities with execution of the work during the course of construction to allow Cx participants and the authority having jurisdiction (AHJ) to fulfill

- their responsibilities for witnessing tests and reviewing installation before concealment of work.
- .3 Coordinate start-up of electrical motors supplied as specified in the relevant Sections of other Divisions of the Contract Documents, with the equipment supplier.
 - .4 Review interfaces with other work to ensure submittals and installation requirements are coordinated with other trades, including:
 - .1 Electrical distribution serving equipment supplied as specified in the relevant Sections of other Divisions of the Contract Documents, including disconnects and starters.
 - .3 Notification: notify the DCC Representative and CxA of activities associated with the commissioning process in accordance with Section 01 91 13 - General Commissioning Requirements.
 - .4 Commissioning Conferences: conduct commissioning meetings attended by DCC Representative, CxA, Contractor and electrical subcontractors in accordance with Section 01 91 13 - General Commissioning Requirements and as follows:
 - .1 Before starting work: to review mock-up requirements and factory testing of systems, components and/or equipment.
 - .2 Coordination of integrated systems: to review and coordinate interfaces of electrical equipment and meters to ensure they connect with systems specified in the relevant Sections of Division 25 of the Contract Documents.
 - .3 During execution of work but before start of commissioning activities: to refine the Cx Plan, commissioning documentation and commissioning schedule.
 - .5 Sequencing: perform commissioning activities in general accordance with the commissioning process described in CSA Z320 and CSA Z5000, maintaining the systematic approach to completing and obtaining acceptance for each phase of commissioning in particular with regards to static verification, start-up and functional performance testing.
 - .1 Functional Performance Testing (FPT): perform operational and performance testing by phases starting with individual components and equipment, testing of sub-systems and then proceeding to FPT of overall systems.
 - .2 Integrated Systems: only perform commissioning of integrated systems once the FPT for each individual system forming part of the integrated system has been completed.
 - .3 Demonstration and training activities may form part of certain commissioning activities, as agreed by DCC Representative and CxA.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Electrical Cx Schedule:
 - .1 Submit proposed schedule before start of commissioning conferences indicating key activities critical to the commissioning process including:
 - .1 Inspection of electrical systems.
 - .2 Commissioning phases: static verification, start-up, functional performance testing, systems orientation, O&M manuals submissions, training sessions.

- .3 Integrated Testing activities.
- .4 Review activities to be completed by other participants: DCC Representative and CxA.
- .2 Review the proposed schedule through the course of the work and notify the DCC Representative and CxA of modifications required.
- .3 Commissioning Forms: Contractor to review and complete forms for documenting static verification and start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.
 - .1 Approved Cx Forms: CxA reviews and approves the final format to use through the commissioning process.
 - .1 Review the forms proposed by CxA and submit comments with proposed adjustments.
 - .2 Contractor may submit its own preferred format for review by the CxA. This may include manufacturer provided checklists.
 - .2 Submit completed static verification and start-up checklists within 48 hours of completion of verification of equipment or system.
- .4 Testing Equipment: submit a list of proposed testing equipment for performing electrical Cx activities and related tests in accordance with Section 01 91 13 - General Commissioning Requirements.
- .5 Site Quality Control Submittals: submit manufacturers certificates and reports demonstrating compliance of Work, as specified in the relevant Sections of Division 26.
- .6 Training Program: submit proposed training program and materials in accordance with Section 01 91 13 - General Commissioning Requirements.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit O&M data and as-built information in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Site Modifications: record changes to installations, system configuration and/or controls that were made during the commissioning process to meet the required performance of electrical equipment and systems.

Part 2 Products

2.1 EQUIPMENT

- .1 Furnish special tools or equipment required for:
 - .1 Verifying or adjusting equipment/system components.
 - .2 Accessing equipment, enclosures or control cabinets.
 - .3 Interfacing with equipment controls or integrated system diagnostics.

- .2 Furnish instruments and equipment required to perform testing and validate performance of electrical systems through the commissioning process or as specified in the relevant Sections of Division 26.

Part 3 Execution

3.1 STATIC VERIFICATION

- .1 Perform static verification of components, equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Verify installation and connection of equipment, sub-systems and systems.
 - .2 Confirm accessibility to electrical equipment and components for inspection and O&M activities.
 - .3 Record equipment and systems information including: manufacturer, model number, serial number and rated capacities.
 - .4 Confirm proper location of lighting control devices as per design and to achieve intended functionality.
 - .5 Confirm completion of labelling and identification of electrical equipment.
 - .6 Confirm identification of circuits in each distribution panel including: circuit labels and a clear panel legend showing the load and a short description of each circuit.
 - .7 Confirm completion and documentation of equipment prestart-up tests, including manufacturer's factory tests.
 - .8 Confirm adequate protection of electrical systems during construction.
 - .9 Confirm electrical systems and service entrance are protected from major precipitation events and minor flooding.
 - .10 Confirm electrical cabinets and enclosures are equipped with protective covers.
 - .11 Confirm seismic and vibration controls for electrical equipment/systems are installed in accordance with design details and manufacturer's recommendations.
- .2 Site Quality Control: CxA to conduct random verification on-site to validate the accuracy of static verification reporting. Contractor to assist the CxA on site to review selected samples representing up to 30 % of the overall installation.

3.2 START-UP

- .1 Refer to Section 01 91 13 - General Commissioning Requirements for commissioning requirements.
- .2 Perform start-up of equipment and systems in accordance with Section 01 91 13 - General Commissioning Requirements and complete the approved Cx Forms in coordination with performing the following activities:
 - .1 Initial site energization.
 - .2 Contractor/manufacturer start-up of equipment.

- .3 Start-up of electrical systems including site electrical tests, and verification and adjustment of overload trips and other protection devices, based on the site's electrical coordination study.
 - .4 Electrical start-up of mechanical equipment including measuring Voltage and Amperage, verifying and adjusting overload trips and other protection devices and verifying phase rotation.
 - .5 Site electrical tests including:
 - .1 Measurement of voltage and voltage drop at major equipment.
 - .2 Confirming phase rotation.
 - .3 Measure insulation resistance of electrical circuits, feeders and equipment. with a megohmmeter to confirm proper resistance values in accordance with NETA standards.
 - .4 Harmonic measurements.
 - .5 Power factor measurements.
 - .6 Verification of proper load balancing.
 - .7 Conducting thermographic surveys on electrical switchgear, circuit panels, and transformers while the system is under load.
 - .8 Start-up and testing of on-site power generation systems such as generator sets and renewable energy generation systems.
- .3 Site Quality Control: DCC Representative, CxA and the AHJ will witness start-up activities for selected equipment. Notify the DCC Representative, CxA and the AHJ of start-up activities in accordance with Section 01 91 13 - General Commissioning Requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- .1 Perform Functional Performance Testing (FPT) on electrical equipment and systems in accordance with 01 91 13 - General Commissioning Requirements and as directed by the DCC Representative and CxA.
- .2 Operate equipment as directed by DCC Representative or CxA to demonstrate and validate that equipment, sub-systems and systems function and perform in accordance with design requirements.
- .3 FPT activities include:
 - .1 Verify proper operation of electrical systems and equipment in the following modes of operation:
 - .1 Systems operation on normal power.
 - .2 Systems operation on generator power.
 - .3 Normal operation - no alarm conditions.
 - .4 Systems operation in alarm condition.
 - .5 Manual operation mode.
 - .6 Automatic operation mode.
 - .2 Verify operation of generator and generator power systems including:

- .1 Performance and switching operation of generator equipment, automatic transfer switches and uninterruptible power systems.
- .2 Verify generator interface to the generator ventilation system, fire alarm system, fire suppression system and building EMCS.
- .3 Verify operation of safety cutouts, alarms and interlocks.
- .4 Verify operation of emergency lights.
- .5 Confirm alarms are generated and transmitted effectively to the intended notification system (e.g. pilot light, control panel, EMCS, remote surveillance system).
- .6 Verify full integration of on-site power generation systems in all modes of operation.
- .7 Verify metering equipment is calibrated and properly reporting energy data on displays and integrated systems.
- .8 Conduct receptacle testing.
- .9 Verify illumination measurements and adjust lighting output levels to achieve design levels.
- .10 Optimize interior and exterior lighting controls including scheduling, occupancy sensor settings and daylight sensor calibration.
- .11 Verify system response to the following emergency conditions:
 - .1 Full or partial loss of grid power.
 - .2 Loss of fuel to back-up power generation systems.

3.4 CX OF INTEGRATED SYSTEMS

- .1 Operate equipment as directed by DCC Representative and CxA to perform commissioning of integrated systems.
- .2 Verify integration between the lighting control system and the EMCS where inter-system communication is required for optimizing operation of other building systems such as HVAC.

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: obtain certificates and reports from manufacturer verifying compliance of Work and submit Manufacturer's Site Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Provide manufacturer's site services to complete start-up activities and assist in Functional Performance Testing as specified in the relevant Sections of Division 26.

3.6 CLOSEOUT ACTIVITIES

- .1 Corrections: Provide equipment, materials and labor as required to correct installation and/or equipment deficiencies identified through the commissioning process.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, components, cabinets, instruments and installation of metering.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 American National Standards Institute, (ANSI)
 - .1 ANSI C39.1, Requirements - Electrical Analog Indicating Instruments.
 - .2 ANSI C12.1, National Standard for Electric Meters – Code for Electricity Metering
 - .3 ANSI C12.20, National Standard for Electric Meters – 0.2 Accuracy Class
- .2 Canadian Standards Association, (CSA)
 - .1 CAN3-C17-M84, Alternating - Current Electricity Metering
 - .2 CAN3-C22.2 No.115, Meter-mounting devices
 - .3 CAN3-C13-M83, Instrument Transformers (Current Transformer)
- .3 Ontario Electrical Safety Code, (OESC)
 - .1 OESC – Metering Equipment Section 6-400
- .4 Institute of Electrical and Electronics Engineers, (IEEE)
 - .1 IEEE C57.13 Standards – Requirement for Instrument Transformers (Current Transformer)

1.4 PRODUCT DATA

- .1 Indicate meter, and instrument, outline dimensions, panel drilling dimensions and include cut-out template.

1.5 PRODUCT APPROVAL

- .1 Electrical components shall be CSA approved.
- .2 Meter panel assembly shall be ESA approved.

Part 2 Products

2.1 METER

- .1 Power supply

- .1 120-240V AC
- .2 110-300V DC
- .2 Voltage Inputs:
 - .1 Support direct connection of low voltage circuits up to 600V (UL) or 690V (IEC) without need for voltage (potential) transformers.
 - .2 Minimum of 4 phases, neutral and ground inputs.
- .3 Current Inputs:
 - .1 Minimum of five (5) inputs
 - .2 Support nominal input current of 5A.
- .4 Meter Instantaneous RMS Values:
 - .1 Current, Average current, Individual phase current
 - .2 LV and HV voltage
 - .3 frequency
 - .4 Active, Reactive, Apparent power (total and per phase)
 - .5 Power factor (total and per phase)
- .5 Support Measured and Calculated Metering Parameters:
 - .1 full range of 3-phase voltage, current, power and energy measurements, % unbalance, power factor (true & displacement – per phase and three-phase) demand (min/max, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current and voltage harmonics readings
- .6 Power Quality Measurement:
 - .1 Harmonic distortion for current and voltage
 - .2 Individual harmonic per phase
 - .3 Waveform capture
 - .4 Sag/Swell
 - .5 Flicker measurements
- .7 Energy accuracy (IEC/ANSI C12.16/ANSI C12.20): 0.2
- .8 Communication:
 - .1 Multi-port Ethernet and serial communications with at least two (2) Ethernet ports and two (2) RS485 serial ports.
 - .2 Ethernet ports support IPv4 and IPv6 with DHCP IP address assignment and offer E-mail on alarm, E-mail interval energy data, customizable web server, SNMP network management with traps, PTP and NTP time synchronization.
 - .3 Ethernet-to-serial RS-485 gateway functionality.
 - .4 Industrial communication protocols include Modbus, DNP3, and IEC 61850.
 - .5 Provide enhanced cybersecurity features that include but are not limited to HTTPS in accordance with TLS 1.2.
 - .6

- .9 On-Board Data Logging (provision for remote and local access to data log via manufacturers software no third-party program):
 - .1 Data log and Event Log
 - .2 Trending/forecasting
 - .3 Sequence of event recording
 - .4 Time stamp
 - .5 Alarms with time stamps
- .10 Display:
 - .1 Front panel display.
 - .2 Function keys on the front of the display panel
 - .3 High-visibility color graphical display with the following characteristics
 - .4 User programmable to display up to 20 parameters per screen.
 - .5 Capable of displaying graphical metering data including at minimum spectral components, phasor diagrams, and trending charts.
 - .6 Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
- .11 Cybersecurity:
 - .1 Ability to independently enable or disable communication ports, enable or disable communication protocols per communications port, and assign TCP/IP port numbers per communications protocol.
 - .2 Provide a Security log to capture security related events such as log-in / log-out (whether successful or failed), configuration changes, resets, and other events identifying the date and time of the event and the user name of the requestor.
 - .3 Support Syslog protocol to deliver security events to a network management server.
 - .4 Design to include a Trusted Platform Module (TPM).
- .12 Alarm Functions:
 - .1 Set-point driven alarming capability.
 - .2 Generate an E-mail notification on an alarm condition.
 - .3 Millisecond resolution timestamp of alarm entries.
- .13 Power Quality Analysis and Compliance Monitoring:
 - .1 Without separate software, have the following capabilities
 - .1 Display statistical indicators of power quality on the front display.
 - .2 Provide statistical indicators of power quality that include, but are not limited to, voltage dips and swells, harmonics, frequency, rapid voltage changes and mains signaling in accordance power quality standard.
 - .3 Low pass anti-aliasing signal filters meeting the requirements of IEC 61000-4-7.
- .14 Fault Recording and Waveform Capture:
 - .1 Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.

- .2 Ability to record sixty (60) cycles with thirty (30) cycles prior to the fault at 1024 samples per cycle minimum
- .15 Disturbance Detection:
 - .1 High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
 - .2 Detect disturbances less than one cycle in duration.
- .16 Other Features
 - .1 Custom programming by users
 - .2 Downloadable firmware by users
- .17 Exterior Network Port
 - .1 Install an Ethernet port on the exterior of the panel and connect to the meter Ethernet port.
 - .2 The Ethernet port shall be location on the bottom side of the enclosure and have a cover to prevent foreign material infiltration.

2.2 METER SOFTWARE

- .1 The meter software shall have provision for remote and local access to data log via the meter manufacturers software no third-party program or software.
- .2 Furnish a dedicated, edge control, software platform (The Software Platform) that is purpose-built to be the operational interface for an Energy and Power Management System (EPMS) whose primary purpose is to support the provision and management of safe, reliable and efficient power within buildings and facilities. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:
 - .1 Electrical Distribution System Monitoring and Alarming.
 - .2 Electrical System Capacity Management.
 - .3 Power Quality Monitoring and Compliance.
 - .4 Multi Source Management.
 - .5 Continuous Electrical Thermal Monitoring.
 - .6 Power Events Analysis.
 - .7 Energy Usage Analysis and Energy Benchmarking.
 - .8 Utility Bill Verification and Cost Allocation.
 - .9 Energy Performance Analysis and Verification.
- .3 The Software Platform shall natively support (no additional installation or configuration of the software required) at least 161 devices specifically designed for power distribution and power quality monitoring including: programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, uninterruptable power supplies, active harmonic filters, capacitor bank controllers, electrical distribution thermal sensors.
 - .1 All registers are to be pre-mapped to standard measurement names – no additional register mapping required.

- .2 All native device types will come with a comprehensive set of a factory device graphical screens – no additional graphics creation or installation required.
- .3 All native device types have been factory-tested and proven to perform.
- .4 The Software Platform shall intelligently and automatically acquire data from devices, including onboard events, trends and waveforms from natively-supported device types:
 - .1 Without any need for software configuration or data upload scheduling.
 - .2 Onboard, high resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP (Precision Time Protocol).
- .5 The Software platform shall support the integration of Windows Active Directory for users and groups from across multiple domains to facilitate the following:
 - .1 Login to the Software Platform using Windows credentials.
 - .2 Role-Based Access Control (RBAC).
- .6 The Software Platform shall provide the ability to send email notifications based on recent changes to the system which will be used to formulate notification types including:
 - .1 Communication Loss Notification – sent when the Software Platform loses communication with selected devices.
 - .2 Alarm Summary Notification – sent regularly to indicate changes in the average amount of high, medium, and low priority alarms.
 - .3 Power Quality Event Notification – sent regularly to indicate changes in the average amount, duration, and magnitude of Sag, Swell and Transient power disturbances.
- .7 The Software Platform shall have a web-based Alarm Configuration interface to allow end users to create smart alarms.
- .8 The Software Platform shall support Auto Network Diagram Creation whereby a comprehensive set of linked hierarchical graphical diagrams is automatically created for all directly connected devices in the power monitoring network.
- .9 The Software Platform shall allow web client users to quickly and easily create interactive dashboard visualization of any real-time measurements that:
 - .1 Display tabular and trend line views to compare device readings from multiple devices in the power monitoring network including power meters, circuit breakers, protection relays, uninterruptable power supplies, automatic transfer switches and generators.
 - .2 Permit users to create, modify, view and share views directly from the web client browser without the need for a separate software application.
 - .3 Support both physical and virtual devices defined in the system.
 - .4 Support exporting real time data into Excel formats directly from the web client browser environment.

2.3 TEST SWITCH (SHORTING BLOCK)

- .1 Mounted to the front of the metering enclosure with a clear cover.
- .2 CT's switches shall be shorted to ground in the open position.

- .3 Voltage switches.

2.4 CURRENT TRANSFORMER

- .1 Split-Core CT's
- .2 Secondary output: 5A
- .3 Insulation Rating: 600V
- .4 Current Ratio for the CT's shall be determined by the [Contractor] for each building
- .5 CT accuracy shall adhere to IEEE C57.13 standards

2.5 TERMINAL BLOCK

- .1 Current Rating: 10A min
- .2 Voltage Rating: 600V
- .3 Din rail mount
- .4 Touch safe terminal block

2.6 FUSED TERMINAL BLOCK

- .1 Current Rating: 10A min
- .2 Voltage Rating: 600V
- .3 Fuse terminal block for meter power shall be two poles
- .4 Fuse terminal block meter voltage shall be single pole
- .5 LED fuse indicator
- .6 Touch safe fuse terminal block

2.7 STEP DOWN TRANSFORMER FOR 600V SYSTEMS

- .1 A step-down transformer shall be installed in buildings with 600V power distribution systems.
- .2 Over-current protection shall be installed on the primary side of the transformer.
- .3 Primary Voltage: 600V
- .4 Secondary Voltage: 120V
- .5 Phase: Single Phase
- .6 Frequency: 60Hz

- .7 Transformer Size: 500Va

2.8 METER CABINET

- .1 CSA NEMA 12 approved steel enclosure with backplate, to accommodate terminal blocks, fuse terminal blocks, associated equipment (transformer and wire ways). The enclosure door must be hinged with a ground post and a door closing mechanism.
- .2 The enclosure shall have a lockable mechanism or anti-tamper mechanism restrict access to authorized personnel only.

2.9 SUBMITTALS

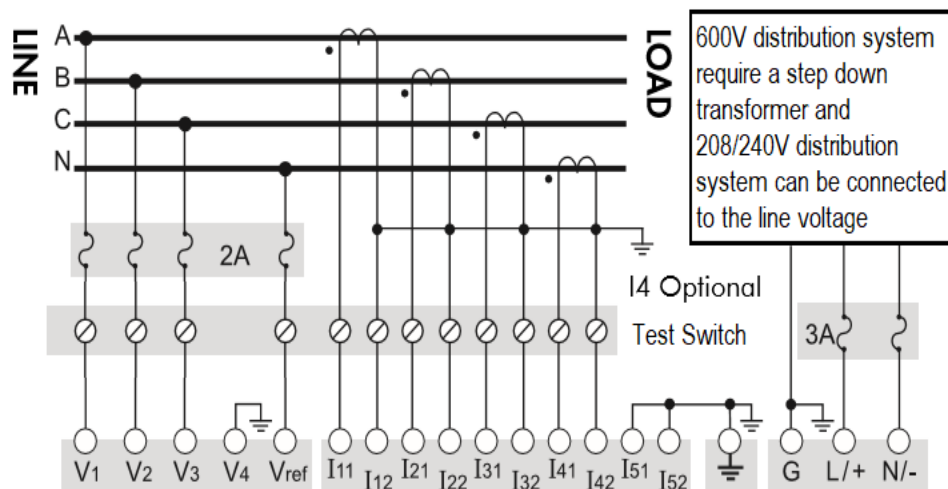
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping and other items that must be shown to ensure coordinated 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 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
- .2 Submit test results of installed electrical systems and instrumentation.
- .3 Submit, upon completion of Work, load balance report as described in sentence 3.4.6.
- .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Owner's Representative.
- .6 Provide the following information on all submittals:
- .1 Manufacturer's and Supplier's name
- .2 Catalogue model number

2.10 SHOP FABRICATION

- .1 Generate a wiring schematic and enclosure layout diagram which will require [DCC and DND approval] and ESA approval prior to the commencement of enclosure fabrication.
- .2 Install meters and test switch flush on the front door on the enclosure. Install bond wire to enclosure door.
- .3 Install terminal block, fuse block, wire way, step down transformer (as required) to enclosure back plate.

- .4 Install internal wiring and label wires as per schematic.
- .5 Verify correctness of connections, polarities of meters and current transformers.

2.11 METER WIRING DIAGRAM (TYPICAL)



Part 3 Execution

3.1 METERING INSTALLATION

- .1 Install metering enclosure in a location free from vibration, shock and within 3 m of the voltage and current transformers (CT's) connection point. Use #10 AWG wire for the current transformer and #12 AWG for the voltage wiring. Use 16 mm conduit and use a separate conduit for the current transformer wires, exclusive for metering.
- .2 If applicable, ensure power factor corrective equipment is connected on load side of meter.
- .3 Connect meter enclosure, test switch and current transformer to ground.
- .4 Install current transformers for each phase on the line side of the service entrance switch.
- .5 Install voltage taps wires for each phase on the line side of the service entrance switch.
- .6 Make connections in accordance with diagrams.
- .7 Installation must be inspected by ESA.

3.2 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00- Common Work Results.
- .2 Commission the meter in accordance with manufacturer's recommendations.

- .3 Perform simulated operation tests with metering disconnected from permanent signal and other electrical sources.
- .4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, signal sources and electrical supplies.
- .5 Perform tests to obtain correct calibration.
- .6 Do not dismantle meters and instruments.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - .1 ANSI/IEEE 386, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-C2, Single-Phase and Three Phase Distribution Transformers, Types ONAN and LNAN
 - .2 CAN/CSA-C227.3, Low-Profile, Single-Phase, Pad-Mounted Distribution Transformers with Separable Insulated High-Voltage Connectors
 - .3 CAN/CSA C227.4, Three-phase, pad-mounted distribution transformers with separable insulated high-voltage connectors

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 printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .3 Submit shop drawings and indicate:
 - .1 Anchoring method and dimensioned foundation template.
 - .2 Dimensioned cable entry locations.
 - .3 Dimensioned cable termination and pothead height.
- .4 Identified internal and external component layout on assembly drawing.
- .5 Insulating liquid capacity.
- .6 Submit primary fuse and secondary breaker time-current characteristics.
- .7 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: Submit production certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: Submit manufacturer's installation instructions.
 - .1 DCC Representative will make available 1 copy of systems supplier's installation instructions.
- .8 Closeout Submittals:

- .1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include insulating liquid maintenance data.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.4 MAINTENANCE

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 EQUIPMENT

- .1 Three phase dead front pad mounted distribution transformers: To CSA C227.4
- .2 Separable insulated connectors for power distribution systems above 600 V: To ANSI/IEEE 386
- .3 Oil filled pad mounted distribution transformer complete with primary and secondary cable compartments, primary fused options and accessories to form complete factory assembled, self contained, steel fabricated unit for mounting on concrete pad or precast concrete base.
- .4 High voltage bushings or high voltage bushing well for connection to distribution system through separable insulated connectors for dead front operation.
- .5 Separable insulated connectors.
- .6 Primary cable terminals with solderless connectors.
- .7 Spade type low voltage terminals.
- .8 Connectors for primary and secondary cables.
- .9 Primary protection oil immersed fuse.
- .10 Separate padlocking for primary compartment door.
- .11 Load break inserts for elbow connectors.
- .12 Stays to hold compartment doors in 110 degrees open position.

2.2 TRANSFORMER CHARACTERISTICS

- .1 Primary Voltage 4.16/2.4 kV, 60 Hz, wye connected, 3 phase, neutral.

- .2 Secondary Voltage: 120/208V, wye connected, 3 phase, 4 wire, neutral grounded.
- .3 Capacity: as indicated on drawings
- .4 Basic Impulse Level: 95 kV
- .5 Maximum rms Short-circuit: 3 times base current for 6 cycles.
- .6 Impedance: not more than 5.75%.
- .7 No load losses not to exceed 2% of kW rating.
- .8 Full load losses not to exceed 5.75% of kW rating.

2.3 VOLTAGE TAPS

- .1 Four-2.5% taps, 2-FCAN, 2-FCBN.

2.4 TAP CHANGER

- .1 Internally operated off-load tap changer, with provision for padlocking on 3 phase units.

2.5 ACCESSORIES

- .1 Liquid temperature thermometer with two sets of contacts.
- .2 Liquid level gauge with two sets of contacts.
- .3 Pressure relief device.
- .4 27 mm drain valve.
- .5 27 mm filler plug.
- .6 Tap switch.

2.6 GROUNDING

- .1 Copper grounding bus, sized to suit connected grounding conductors. Minimum 13mm wide, 6mm thick
- .2 Connectors for grounding conductors size as indicated.

2.7 DIELECTRIC FLUID

- .1 Dielectric fluid shall be fire resistant, biodegradable, FR3 type.

2.8 FINISH

- .1 Finish exterior of unit 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.
- .2 Nameplate showing information in accordance with CSA C2.

2.10 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.11 SOURCE QUALITY CONTROL

- .1 Submit to DCC Representative standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

Part 3 Execution

3.1 INSPECTION

- .1 Check factory made connections of transformer unit for mechanical security and electrical continuity.
- .2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.2 INSTALLATION

- .1 Ensure concrete pad is fully cured before transformer is installed.
- .2 Set and secure transformer unit in place, rigid, plumb, and square.
- .3 Make connections.
- .4 Connect transformer unit ground bus to system ground.
- .5 Wire one set of contacts on liquid temperature thermometer and liquid level gauge, to sound alarm when unsafe condition reached.
- .6 Ensure care is taken to prevent contamination of liquid and components when filling transformer on site.
- .7 Use only metal hose when site-filling transformer with oil: do not use rubber hose.

- .8 Set taps to produce rated secondary voltage at no-load.

3.3 SITE QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Carry out following insulation tests using megger with 20 000 megohm scale and resulting insulation resistance corrected to base of 20 degrees C.
- .1 High voltage to ground with secondary grounded for duration of test.
- .2 Low voltage to ground with primary grounded for duration of test.
- .3 High to low voltage.
- .3 Inspect primary and secondary connections for tightness and for signs of overheating.
- .4 Inspect and clean bushings and insulators.
- .5 Check oil level and temperature indicators.
- .6 Set transformer taps to rated voltage as specified.
- .7 Inspect for oil leaks and any rusting.
- .8 Inspect oil level.
- .9 Check fuses for correctness of type and size.
- .10 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning & Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.2 No.31, Switchgear Assemblies.

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 service entrance board 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 the Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
 - .3 Include time-current characteristic curves for circuit breakers and fuses.
- .4 Test and Evaluation Reports:
 - .1 Submit 1 copy of certified test results in electronic PDF format.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals].

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for service entrance board for incorporation into manual.
- .3 Submit 1 copy of operation and maintenance manual in electronic PDF format.

1.6 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 service entrance board 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 of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 COORDINATION AND ARC FLASH STUDIES

- .1 Submit co-ordination and arc flash study of electrical protection devices, prepared by low Voltage switchgear manufacturer. The co-ordination study and arc flash study shall be carried out as soon as the electrical contract is awarded and the suppliers of electrical equipment selected so that the electrical subcontractor can ensure that all equipment ordered complies with the requirements established by the co-ordination study and arc flash study. The co-ordination study and arc flash study shall encompass the new electrical service, new service entrance switchboard and the new distribution equipment inside building. The two studies shall be coordinated to provide an integrated report. Electrical contractor is responsible for verifying all equipment quantities and locations on site for the arc flash analysis, the existing service entrance switchboard is to be included.
- .2 The co-ordination study shall include at least the following:
 - .1 Comprehensive fault calculations.
 - .2 Verification and selection of protection relays and determining the correct pick-up and time delay, etc., settings.
 - .3 Determine the correct settings and interrupting capacities of all protective devices.
 - .4 Correct selection and settings of motor protection.
 - .5 Determine all fuse types and sizes.
 - .6 Trip curves coordinated with the utility protection elements and each other.

- .7 Ground fault protection curves, coordinate with each other and downstream protection elements.
- .8 Damage curves for all equipment and cables, co-ordinate with the pertinent protective devices.
- .9 Complete single line diagram(s) showing protective device sizes, trip settings, interrupting capacities and system fault levels.
- .10 Prepare graphic co-ordination curves on log-log time current characteristics sheets. Prepare separate sheets for the various power distribution elements to maintain clarity. Comply also with the utility's specific requirements. Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the pertinent portion of the system.
 - .2 The pertinent protection curves.
 - .3 The pertinent damage curves.
 - .4 The system fault level(s).
 - .5 The selected settings of the protection elements.
 - .6 Ground fault protection curves.
- .3 Co-ordination study to recommend protective device settings and short circuit interrupting capacities which results in greatest degree of selective co-ordination.
- .4 Co-ordination study to be submitted for approval prior to manufacture of major equipment.
- .5 Arc flash hazard analysis shall be provided in accordance with the following:
 - .1 The arc flash hazard analysis shall be performed with the aid of a digital computer in order to calculate Arc Flash Incident Energy (AFIE) levels and arc flash protection boundary distances.
 - .2 The arc flash hazard analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.
 - .3 Results of the arc flash hazard analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
 - .4 Circuits less than 100 amperes may be omitted from the computer model and will be assumed to have a hazard risk category 0.
 - .5 The arc flash hazard analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
 - .6 The arc flash hazard analysis shall be performed by a registered professional engineer.
 - .7 The arc flash hazard analysis shall be performed in compliance with IEEE standard 1584-2002, the IEEE guide for performing arc flash calculations.
 - .8 The arc flash hazard analysis shall include recommendations for reducing AFIE levels and enhancing worker safety.
 - .9 The arc flash hazard analysis shall report incident energy values based on the existing incident energy values at all buses within the scope of the study in addition to incident energy values based on the recommended overcurrent device setting changes.

- .10 The proposed vendor shall have considerable experience performing arc flash hazard analysis studies using software such as ETAP, SKM, Easy Power or similar, in compliance with IEEE 1584 and NFPA 70E standards. Analysis report to indicate incident energy levels at key system busses and to detail the required PPE at those locations.
- .11 The proposed vendor shall provide equipment labels. The labels shall comply with relevant CSA Standards as well as UL 969 and must include the following information:
 - .1 Equipment name
 - .2 AFIE flash hazard boundary
 - .3 AFIE value (cal/cm²)
 - .4 Hazard risk category
 - .5 System voltage
 - .6 Limited approach boundary
 - .7 Restricted approach boundary
 - .8 Prohibited approach boundary
- .12 The data fields on the label shall be populated from the results of the arc flash hazard analysis. Where circuits have been omitted from the computer model as permitted by an applicable industry standard a generic label shall be provided.
- .13 Include AFIE label installation. Apply labels to all panels to ANSI Z535.4 (even if they are exempt under .14 below)
- .14 Single phase AC distribution systems are not included in the scope of the analysis.

Part 2 Products

2.1 SERVICE ENTRANCE BOARD

- .1 Service Entrance Board: to CSA C22.2 No.31
- .2 Rating: 120/208V, 3 phase, 4 wire, amperage as indicated in the drawings, short circuit current 25 kA (rms symmetrical) or as provided in the short-circuit study, whichever is the higher value.
- .3 Cubicles: free standing, dead front, size as indicated.
- .4 Barrier metering section from adjoining Sections.
- .5 Provision for installation of power supply authority metering in barriered Section.
- .6 Owners metering.
- .7 Distribution section.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections: 99.3% copper.

- .10 Bus from load terminals of main breaker into metering section] and cable to automatic transfer switch then to distribution panel.

- .11 Identify phases with colour coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 3-pole main breaker with amperage and trip ratings as indicated on the drawings. 25 kAIC rated with long, short and instantaneous trip as per requirements of Section 26 28 16.02 – Molded Case Circuit Breakers

2.3 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size #3 AWG grounding cable.

2.4 OWNER's METERING

- .1 Separate compartment and metal raceway for exclusive use of owner's metering equipment.
- .2 Refer to Section 26 09 23.01 Metering and Switchboard Instruments for equipment details.

2.5 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .1 Service entrance board exterior: gray.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: "120/208V."
 - .3 Main disconnect labelled: "Main Breaker ".
 - .4 Branch disconnects labelled: as indicated on Drawings.

2.7 SOURCE QUALITY CONTROL

- .1 DCC Representative to be given opportunity to witness final factory tests.
- .2 Notify DCC Representative in writing 5 working days in advance that service entrance board is ready for testing.

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 service entrance board installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Mount floor mounted equipment on 103mm high housekeeping pad.
- .2 Locate service entrance board and secure to wall.
- .3 Connect main secondary service to line terminals of main breaker.
- .4 Connect load terminals of distribution breakers to feeders.
- .5 Check factory made connections for mechanical security and electrical continuity.
- .6 Run one grounding conductor 4/0 AWG bare copper in 27 mm conduit from ground bus to building main ground.
- .7 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 for Electrical
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No.29 – Panelboards and Enclosed Panelboards

1.3 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 each type of panelboard, including product characteristics, performance criteria, ratings, physical sizes, finishes, and limitations.
 - .2 Shop Drawings: Stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
 - .1 Indicate electrical details of panel, branch breaker type, quantity, ampacity, ratings, knockouts, cable entry and exit locations, and enclosure dimensions.
 - .2 Include a Circuit Directory Schedule.
- .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.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Include the following in the operation and maintenance manual:
 - .1 Manufacturer's maintenance and operating instructions.
 - .2 Recommended cleaning materials and methods.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 PANELBOARDS - GENERAL

- .1 Panelboards: To CSA C22.2 No.29. All panelboards from a single manufacturer.
 - .1 Factory install circuit breakers in panelboards.
 - .2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel, including breakers, has been built to withstand.
 - .3 Provisional space: Fully bussed and breaker ready.
- .2 Panelboards: Mains, number of circuits, and number and size of branch circuit breakers as indicated on Drawings.
- .3 Minimum of two flush locks for each panelboard.
- .4 Supply two keys for each panelboard. Key all panelboards alike.
- .5 Double Tub Panels: Bolt together with trim.
- .6 Provide flush-or surface-mounted tubs as required.
- .7 Trim with concealed front bolts and hinges.
- .8 Trim and Door Finish: Gray enamel paint electro-deposited over cleaned phosphatized steel.
- .9 Provide sprinkler-proof enclosures for panelboards in sprinklered areas.

2.2 PANELBOARDS

- .1 120/240 or 347/600 V Panelboards: Bus and breakers rated for minimum 10kA (symmetrical) interrupting capacity for 240V and minimum 22kA (symmetrical) interrupting capacity for 600V, or as indicated in the short-circuit study, whichever value is higher.
- .2 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.
- .3 Copper bus with neutral of same ampere rating of mains.
- .4 Breakers: Meeting requirements of Section 26 28 16.02 - Moulded Case Circuit Breakers and as follows:
 - .1 Main Breaker: Separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
 - .2 Breakers with thermal and magnetic tripping, except as indicated otherwise.
 - .3 Connect branch circuit breakers to the panelboard bus bar per manufacturer's standard bolt-on electrical connection for mechanical restraint.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use size 4 engraved nameplate for each panelboard as indicated on Drawings.
 - .1 Line 1: Panel identification.
 - .2 Line 2: Amperage of feeder, breaker, voltage, and wire.
 - .3 Line 3: Fed from panel and room number.
- .3 Use size 2 engraved nameplate for each circuit in power distribution panelboards as indicated on Drawings.
 - .1 Line 1: Panel identification.
 - .2 Line 2: Panel location (Room Number).
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit mounted inside of panel door, behind transparent plastic cover. Identify each circuit with sufficient detail to distinguish from all others.

Part 3 Execution

3.1 EXAMINATION

- .1 Pre-Installation Testing:
 - .1 Test factory-made connections are mechanically secure.
 - .2 Test electrical continuity.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true, and square to adjoining surfaces.
- .2 Install surface-mounted panelboards on plywood backboards or on strut channels. Where practical, group panelboards on common backboard or strut channels.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus bar

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.42- General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55, Special Use Switches.
 - .4 CSA C22.2 No.111, General-Use Snap Switches (Trinational standard with UL 20 and NMX-J-005-ANCE)

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 wiring devices 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 the Province of Ontario, Canada.

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 wiring devices 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 wiring devices 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 of 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 SWITCHES

- .1 20 A, 120 V or 347 V, single pole, three-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament, fluorescent ballasts and LED drivers, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 5-20 R, 125 V, 15 A and 20A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 5-20 R, 125 V, 15 A and 20A, U ground, with the following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.

- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 plastic ivory cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes and in service rooms.
- .5 Weatherproof clear 'while in use' spring-loaded covers, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.

2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

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 wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .2 Receptacles:

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management .
 - .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 & Waste Management .
- .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 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CAN/CSA C22.2 No. 248 series, Low Voltage Fuses (Tri-National Standard with UL 248 series and NMX-J-009 / 248 series).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 100 A. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard or disconnect switches.
- .3 Store fuses in original containers in storage cabinet.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three spare fuses of each type and size installed above 100 A.
- .3 Six spare fuses of each type and size installed up to and including 100 A.

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 L fuses.
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
- .2 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.
- .3 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
- .4 Class C fuses.

2.3 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum, 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

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.

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END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

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 circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with ampacity of 100 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 1 copy of a production certificate of origin from the manufacturer in electronic PDF format. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to DCC Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by DCC Representative. Unless complying with this requirement, DCC Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed:

- .1 Project title: Construct New Workshop, CFB Kingston, Ontario
- .2 DCC Project No.: KN229975

1.3 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 circuit breakers off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this.
- .5 Packaging Waste Management: remove for reuse and return of 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 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 as indicated.
- .6 120/240 Volt Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating. Actual rating to be determined from short circuit study.
- .7 347/600 Volt Circuit breakers to have minimum 22kA symmetrical rms interrupting capacity rating. Actual rating to be determined from short circuit study.

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 SOLID STATE TRIP BREAKERS (DESIGN D)

- .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 fault short circuit protection.

2.5 OPTIONAL FEATURES

- .1 Include:
 - .1 Shunt trip.
 - .2 Auxiliary switch.
 - .3 Under-voltage release.
 - .4 On-off locking device.
 - .5 Handle mechanism.

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 installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 C22.2 NO. 144.1 – Ground-fault circuit-interrupters (Tri-national standard with UL 943 and NMX-J-520-ANCE)
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

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 ground fault circuit interrupters 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 the Province of Ontario, Canada.
- .4 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to DCC Representative and certificate that system as installed meets criteria specified.

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 ground fault circuit interrupters 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 ground fault circuit interrupters 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 of 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 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.1.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single pole ground fault circuit interrupter for 15 A and 20 A, 120 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A and 20 A, 120 V circuit interrupter and duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure 1, flush mounted with painted face plate.

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 ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Pass phase conductors including neutral through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical
- .2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 for Electrical
- .2 Section 26 28 13.01 - Fuses - Low Voltage

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

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 disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

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 disconnect switches - fused and non-fused 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 of 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 DISCONNECT SWITCHES – FUSED

- .1 Fusible, Horsepower rated disconnect switch in CSA enclosure to CAN/CSA-C22.2 No.4, size as indicated.
- .2 Provision for padlocking in OFF switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, 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 indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 DISCONNECT SWITCHES – UNFUSED

- .1 Non-fusible, Horsepower rated disconnect switch in CSA enclosure to CAN/CSA-C22.2 No.4, size as indicated.
- .2 Provision for padlocking in OFF switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

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 disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 for Electrical

1.2 REFERENCE STANDARDS

- .1 American Petroleum Institute (API):
 - .1 API Std. 650- Welded Steel Tanks for Oil Storage Current Edition
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-3.6- Regular Sulphur Diesel Fuel – Current Edition
- .3 Canadian Environmental Protection Act (CEPA):
 - .1 CCME PN 1326- Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products
 - .2 CCME PN 1299 – Canadian Environmental Quality Guidelines
- .4 CSA Group (CSA):
 - .1 CSA B139 Series- Installation Code for Oil-Burning Equipment
- .5 International Organization for Standardization (ISO):
 - .1 ISO 3046-1 Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use
- .6 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA MG 1- Motors and Generators
- .7 ULC Standards (ULC):
 - .1 CAN/ULC-S601, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids
 - .2 CAN/ULC-S661, Standard for Overfill Protection Devices for Flammable and Combustible Liquid Storage Tanks.
 - .3 CAN/ULC-S663, Standard for Spill Containment Devices for Flammable and Combustible Liquid Aboveground Storage Tanks.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets for power generators 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 the Province of Ontario, Canada and include:
 - .1 Engine: make and model, with performance curves.
 - .2 Alternator: make and model.
 - .3 Voltage regulator: make, model and type.
 - .4 Automatic transfer switch: make, model and type.
 - .5 Manual bypass switch: make and model.
 - .6 Battery: make, type and capacity.
 - .7 Battery charger: make, type and model.
 - .8 Alternator control panel: make and type of meters and controls.
 - .9 Governor type and model.
 - .10 Cooling air requirements in m³ /s.
 - .11 British standard or DIN rating of engine.
 - .12 Flow diagrams for:
 - .1 Diesel fuel.
 - .2 Cooling air.
 - .13 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
 - .14 Continuous full load output of set at 0.8 PF lagging.
 - .15 Fuel tank, fuel piping layout, venting, fill station, and all required accessories as per applicable standards.
 - .16 Description of set operation including:
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
 - .2 Manual starting.
 - .3 Automatic shut down and alarm on:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator over voltage.
 - .7 Lube oil high temperature.
 - .8 Over temperature on alternator.
 - .4 Manual remote emergency stop.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
 - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
 - .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls.
 - .3 Flow diagrams for:
 - .1 Fuel system.
 - .2 Lubricating oil.
 - .3 Cooling system.
 - .4 Certified copy of factory test results.
 - .5 Maintenance and overhaul instructions and schedules.
 - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

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 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 2 fuel filter replacement elements.
 - .2 2 lube oil filter replacement elements.
 - .3 2 air cleaner filter elements.
 - .4 2 sets of fuses for control panel.
 - .5 Special tools for unit servicing.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Generating system consists of:
 - .1 Diesel engine.
 - .2 Alternator.
 - .3 Alternator control panel.
 - .4 Automatic transfer equipment.
 - .5 Battery charger and battery.
 - .6 Automatic engine room ventilation system.
 - .7 Fuel supply system.
 - .8 Exhaust system.
 - .9 Steel mounting base.
 - .10 Base mounted fuel tank
 - .11 Synchronizing panel.
 - .12 Manual by-pass switch.
- .2 System designed to operate as standby.

2.2 DIESEL ENGINE

- .1 Diesel engine: to ISO 3046-1
- .2 Turbo charged and after cooled, synchronous speed 1800 rpm.
- .3 Capacity:
 - .1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.
 - .1 Under following site conditions:
 - .1 Altitude: 1700 m.
 - .2 Ambient temperature: 40°C.
 - .3 Relative humidity: 90%.
- .4 Cooling System:
 - .1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze non-sludging above -46°C.
 - .2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40°C.
 - .3 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0°C.

- .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
- .5 Fuel: to CAN/CGSB-3.6, Type A, Arctic Grade 2-D.
- .6 Fuel system: solid injection, mechanical fuel transfer pump, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
- .7 Governor: mechanical hydraulic with:
 - .1 Steady state speed band of plus or minus 0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .3 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
- .8 Lubrication system:
 - .1 Pressure lubricated by engine driven pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dip-stick.
- .9 Starting system:
 - .1 Positive shift, gear engaging starter 12V or 24V dc.
 - .2 Cranking limiter to provide three (3) cranking periods of 10s duration, each separated by 5 s rest.
 - .3 Lead acid, 12V or 24V storage battery with sufficient capacity to crank engine for 1 min at 0°C without using more than 25% of ampere hour capacity.
 - .4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use.
 - .1 Regulation: plus or minus 1% output for plus or minus 10% input variation.
 - .2 Equipped with dc voltmeter, dc ammeter and on-off switch.
 - .3 Minimum charger capacity: 10 A.
- .10 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.
 - .3 Lube oil level gauge.
 - .4 Coolant temperature gauge.
 - .5 Coolant level gauge.
 - .6 Running time meter: non-tamper type.
- .11 Guards to protect personnel from hot and moving parts.

- .1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .12 Drip tray.

2.3 ALTERNATOR

- .1 Alternator: to NEMA MG1
- .2 Rating: 120/208 V, 3 phase, 4 wire, kW as indicated on drawings, 60 Hz, at 0.8 PF.
- .3 Output at 40°C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1 hour.
 - .3 150% full load for 1 minute.
- .4 Revolving field, brushless, single bearing.
- .5 Drip proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Exciter: rotating brushless.
- .9 NEMA class H insulation on windings.
- .10 Thermistors embedded in stator winding and connected to alternator control circuitry.
- .11 Voltage regulator: integrated digital electronic voltage regulator with phase controlled sensing circuit:
 - .1 Stability: $\pm 1\%$ maximum voltage variation at any constant load from no load to full load.
 - .2 Regulation: 4% maximum voltage deviation between no-load steady state and full-load steady state.
 - .3 Transient: 25% maximum voltage dip on one-step application of 0.8 PF full load.
 - .4 Transient: 30% maximum voltage rise on one-step removal of 0.8 PF full load.
 - .5 Transient: 2.5 s maximum voltage recovery time with application or removal of 0.8 PF full load.
- .12 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

2.4 CONTROL PANEL

- .1 Totally enclosed, mounting base inside diesel generator enclosure.
- .2 Instruments:

- .1 Digital 100% solid state circuitry indicating type 1% accuracy, rectangular face, flush panel mounting with digital indication for RPM, DC Volts, Operating hours, Oil Pressure, coolant temperature, Volts (Line to Line, Line to Neutral), Frequency, Amperage (Per Phase and Average), Electrical kW, kVAR, kW-hour, %kW, PF.

2.5 CONTROLS

- .1 Run/Auto/Stop Controls
- .2 Speed and Voltage Adjust
- .3 Engine Cycle Crank
- .4 Environmental sealed front face
- .5 Text Alarm with Event descriptions.
- .6 Warning/Shutdowns;
 - Low Oil Pressure
 - High Coolant Temperature
 - Overspeed
 - Emergency Stop
 - Failure to Start (Overcrank)
 - Low Coolant Temperature
 - Low Coolant Level.
 - Engine Overspeed
 - Engine High Temperature
 - Engine Low Lubricating Oil Pressure
 - Short Circuit
 - AC Overvoltage
- .7 Alternator output breaker:
 - .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40°C ambient, dual thermal-magnetic trip.
 - .2 Circuit breaker, solid state sensing with:
 - .1 Frame containing breaker contacts, arc quenchers, manual mechanism, quick-make, quick-break, spring-loaded overcenter switching mechanism, mechanically trip free from handle, fixed type.
 - .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
- .8 Load Bank Circuit Breaker:
 - .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40°C ambient, dual thermal-magnetic trip.
 - .2 Circuit breaker, solid state sensing with:

- .1 Frame containing breaker contacts, arc quenchers, manual mechanism, quick-make, quick-break, spring-loaded overcenter switching mechanism, mechanically trip free from handle, fixed type.
- .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
- .3 Shunt trip actuated by signal from static sensor to open breaker contacts in the event the building loses utility power during a load bank test.
- .9 Solid state indicator lights for alarm with 1 set of manually reset, NO/NC contacts, wired to terminal block for remote annunciation on:
 - .1 Low fuel level.
 - .2 Low battery voltage.
 - .3 Ventilation failure.
 - .4 Low coolant temperature.
- .10 Provision for remote monitoring to include all warning and shutdown statuses.

2.6 AUTOMATIC TRANSFER SWITCH

- .1 Refer to Section 26 36 23 – Automatic Transfer Switches

2.7 STEEL MOUNTING BASE

- .1 Complete generating set mounted on 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 and control console resiliently mounted.
 - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.

2.8 EXHAUST SYSTEM

- .1 Heavy duty critical mounted exhaust silencer with condensate drain, plug and flanged couplings.
- .2 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

2.9 FUEL SYSTEM

- .1 Fuel storage tanks to be double walled steel and ULC labelled. Tank shall be sized to allow the generator to run at 100% load for a minimum of 24 hours.
- .2 Sub-base mounted fuel tank to ULC-S601.

- .1 Manufacturer shall design and supply double walled, steel fuel storage tank, of sufficient capacity to provide a minimum of 24 hours continuous operation at full load (100% load).
 - .2 Low voltage level switches for interstitial space leak detection shall be tied to generator control panel for remote monitoring. Two (2) level alarms to monitor the interstitial glycol; high level alarm indicates the inner tank leaked into the interstitial space, raising the liquid level; whereas, the low-level alarm indicates an outer tank leak, where the liquid has leaked out from the interstitial space.
 - .3 Mechanical fuel gauge (ULC Listed) installed in a position with visibility from the fueling port.
 - .4 Accessibly located primary vent equipped with vent cap. Vent must be at least 155mm above the fill, at least 1.5m above grade and located outside the sound enclosure.
 - .5 Accessibly located emergency vent equipped with vent cap. Vent must be at least 155mm above the fill, at least 1.5m above grade and located outside the sound enclosure.
 - .6 Provide 103mm diameter threaded port to allow for onsite installation of fuel level instrument. Locate port near inner wall of sound enclosure. Cap port during generator factory acceptance testing and shipping.
 - .7 Provide two (2) 53mm diameter threaded ports for generator supply and generator return lines.
 - .8 Provide three (3) spare 103mm diameter threaded ports for future use. Cap ports during generator factory acceptance testing and shipping.
 - .9 Fill must be equipped with Overfill protection (ULC-S661-10) and spill containment (ULC-S663-11). The fill must be located outside the sound enclosure.
- .3 Install fuel oil piping system in accordance with CSA B139ON and Ontario Regulation 213/01. Pipes shall be steel Schedule 40, to ASTM A53/A53M, with socket-welding fittings to ASME-B16.11 and B31 Series. Threaded fittings not acceptable.
- .4 Emergency Shutoff (fusible-link) Firesafe Valve
- .1 Threaded ends, stainless steel body – S/S Trim, Viton, fusible link temperature rating 73°C, spring to close, valve sized to suit.
 - .2 Approved part includes Morrison Bros. Co. ® ULC-listed, OPW Retail Fueling, Preferred Utilities Mfg Corporation Figure 446, Bi-Torq and Jamesbury.
- .5 Flexible Pipe Connections
- .1 Flexible pipes connecting supply and return lines to the engine system to be flexible fuel lines, capable of withstanding a fire of short duration, and ULC listed for fuel oil service. No other material is acceptable.
 - .2 Each end of the flexible pipe is to be rigidly held so that the other piping at each end is not under stress.
 - .3 Before selecting a flexible pipe connection, the diesel engine manufacturer should be consulted regarding pressure spikes.
- .6 Provide stainless steel, hinged, pad-lockable enclosure to be mounted outside the sound enclosure over fuel fill port. Provide high level whistle to sound at 90% full.
- .7 Fuel Cooler to be installed on the generator return line as a certified assembly from manufacturer. Return fuel shall not exceed 38°C under all operating conditions.

2.10 COOLING AIR SYSTEM

- .1 Engine ventilating system:
 - .1 Recirculating damper assembly with modulating motor.
 - .2 Cold air inlet damper assembly with modulating motor.
 - .3 Air discharge and intake gooseneck weatherhoods.
 - .4 Modulating thermostat.
 - .5 Replaceable air intake filters.

2.11 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control panel:
 - .1 Size 5 nameplates for control panel and controls including alternator breakers and program selector switch.

2.12 OUTDOOR WEATHER-PROTECTIVE ENCLOSURE

- 1. The generator set shall be provided with an outdoor protective insulated enclosure. The total assembly of generator set and enclosure shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.
- 2. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.
- 3. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two step electro-coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
 - .1 Primer thickness, 0.5-2.0 mils
 - .2 Top coat thickness, 0.8-1.2 mils.
 - .3 Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
 - .4 Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
 - .5 Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.

- .6 Salt Spray, per ASTM B117-90, 1000+ hours.
- .7 Humidity, per ASTM D2247-92, 1000+ hours.
- .8 Water Soak, per ASTM D2247-92, 1000+ hours.
- 4. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
- 5. The enclosure shall include:
 - .1 Locking side panels for servicing.
 - .2 Batteries installed with battery warmer and thermostat and wired with the battery charger.
 - .3 Air inlet and outlet louvers.
- 6. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
- 7. The enclosure shall include the following maintenance provisions:
 - .1 Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure with internal drain valves
 - .2 External radiator fill provision.
- 8. Provide motorized louvers to minimize air flow through the enclosure when generator set is not operating. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation.
- 9. Inlet ducts shall include rain hoods.
- 10. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100F. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 68 dBA at any location 7 meters from the generator set in a free field environment.
- 11. The enclosure shall be insulated with non-hydroscopic materials.
- 12. The nitrogen oxide emission rate of the generator at full load shall be less than or equal to 0.083 g/s.

2.13 FABRICATION

- .1 Shop assemble generating unit including:
 - .1 Base.

- .2 Engine and radiator.
- .3 Alternator.
- .4 Control panel.
- .5 Battery and charger.
- .6 Weatherproof sound attenuating enclosure.

2.14 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .3 Exhaust and inlet air hoods international orange.
- .4 Other ducts and racks grey.
- .5 Supply 0.25 L of grey touch-up enamel.

2.15 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, control panels, transfer switch, weatherproof sound attenuated enclosure and accessories in presence of DCC Representative.
- .2 Notify DCC Representative minimum 7 days in advance of date of factory test.
- .3 Test procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data and at top of first sheet record:
 - .1 Date.
 - .2 Generator set serial no.
 - .3 Engine, make, model, serial no.
 - .4 Alternator, make, model, serial no.
 - .5 Voltage regulator, make and model.
 - .6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.
 - .2 Mark check sheet and record data on forms in duplicate as test proceeds.
 - .3 DCC Representative's signature on completed forms to indicate concurrence in results of test.
- .4 Tests:
 - .1 With 100% rated load, operate set for 24 hours, taking readings at 30 minutes intervals, and record following:
 - .1 Time of reading.
 - .2 Running time.
 - .3 Ambient temp in °C.
 - .4 Lube oil pressure in kPa.

- .5 Lube oil temp in °C.
- .6 Engine coolant temp in °C.
- .7 Exhaust stack temp in °C.
- .8 Alternator voltage: phase 1, 2, 3.
- .9 Alternator current: phase 1, 2, 3.
- .10 Power in kW.
- .11 Frequency in Hz.
- .12 Power Factor.
- .13 Battery charger current in A.
- .14 Battery voltage.
- .15 Alternator cooling air outlet temp.
- .2 After completion of 24 hours run, demonstrate following shut down devices and alarms:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator over voltage.
 - .7 Low battery voltage, or no battery charge.
 - .8 Manual remote emergency stop.
 - .9 High alternator temperature.
- .3 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
 - .1 No load to full load to no load.
 - .2 No load to 70% load to no load.
 - .3 No load to 20% load to no load.
 - .4 20% load to 40% load to no load.
 - .5 40% load to 60% load to no load.
 - .6 60% load to 80% load to no load.
- .5 Demonstrate:
 - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
 - .2 Operation of manual bypass switch.
 - .3 Automatic shut down of engine on resumption of normal power.
 - .4 That battery charger reverts to high rate charge after cranking.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

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 generating enclosure installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 LOCATING AND MOUNTING

- .1 Locate sound attenuated enclosure generator set unit as indicated on a concrete reinforced pad.
- .2 Fit and adjust isolators in accordance with manufacturer's installation and adjustment instruction bulletin contained in unit manual.
- .3 Coordinate exact location of electrical duct stubs with approved shop drawings.

3.3 ALIGNMENT CHECK

- .1 Since engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.

3.4 FUEL SUPPLY SYSTEM

- .1 Inspect thoroughly fuel tank and lines to ensure they are clean and free of foreign material before filling.
 - .1 Entirely replace leaking fuel lines.
 - .2 Protect fuel lines from mechanical damage.
 - .3 Provide fuel required for performing diesel-generator site test and top-up after acceptance test completion.

3.5 BATTERIES AND CHARGER

- .1 For dry charged batteries, activate in accordance with manufacturer's instructions in the unit manual prior to installation.
- .2 For wet batteries, inspect individually each battery cell and check electrolyte level. Check charge condition by measuring temperature and specific gravity of electrolyte. Consult manufacturer's instructions for recommended readings. If readings are lower, give batteries freshening charge until reading are reached.
- .3 Clean connections and tighten securely.

3.6 EXHAUST SYSTEM

- .1 Contractor shall install exhaust Stack in accordance with generator manufacturer's recommendations.

3.7 ADDITIONAL WORKS

- .1 Complete any additional work as instructed by DCC Representative to:
 - Ensure equipment is safe to operate.
 - Provide complete and operating system.

3.8 FIELD QUALITY CONTROL

- .1 Qualified manufacturer service technician and OBT-1 certified technician to inspect and verify that installation of power unit is acceptable and complete. Provide comprehensive TSSA approved comprehensive inspection report and Site Acceptance Test report to the DCC Representative.
- .2 Develop and submit commissioning report including time delay settings, operational set points and adjustment ranges.

3.9 FUEL SUPPLY SYSTEM

- .1 Inspect thoroughly fuel tank and lines to ensure they are clean and free of foreign material before filling.
- .2 Entirely replace leaking fuel lines.
- .3 Protect fuel lines from mechanical damage.
- .4 Mount and connect storage tank radar level transmitter supplied by others.
- .5 Provide fuel required for performing diesel-generator site test and top-up after acceptance test completion.

3.10 SYSTEM STARTUP

- .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 Confirm 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 points.
- .8 Check and tighten properly nuts, bolts.
- .9 Confirm 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 DCC Representative 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 confirm 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.
- .3 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 "test control". Unit start and shutdown, on "engine start" control.
- .3 Unit cranking, start, and shutdown by means of engine-mounted key switch.
- .4 Run unit on full (nameplate) 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, exhaust system.
- .5 Every 1/2 hour carry out and record readings on Test Chart.
 - Perform additional tests as required by DCC Representative to confirm unit is operating satisfactorily.
 - The manufacturer's representative shall be prepared to remain on site until all tests are successfully completed.
 - Provide Site Acceptance Test report including above mentioned test results, time delay settings, operational set points and adjustment ranges. SAT report shall be incorporated into the Commissioning Manual in accordance with Section 01 78 00 – Closeout Submittals.
 - Perform sound level field testing at standby and 100% load condition to confirm the package unit acoustic performance. Submit testing report.
 - Pay for all fuel required for Contractor start up testing, Site Acceptance Testing and tank top up following all testing.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.

3.12 DEMONSTRATION AND TRAINING

- .1 Arrange and pay for on-site training and demonstrations by diesel generator system manufacturer to train operational personnel in use and maintenance of generator equipment. Allow for a sufficient time period of training (minimum four (4) hours).
- .2 System manufacturer shall provide qualified training technicians to provide full instruction and training to the operating and maintenance personnel in the adjustment, operation and maintenance, including:
 - System controls
 - Operations
 - Care and maintenance of equipment
 - Pertinent safety requirements of the equipment and system specified, and
 - Minor troubleshooting

The training shall be oriented toward the system installed rather than being a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.

- The training sessions/seminars shall be video recorded. Submit electronic copies to the DCC Representative.
- Include fuel required for performing diesel-generator site test and top-up after acceptance test completion.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.5- Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
 - .2 CSA C22.2 No.178.1- Automatic Transfer Switches (Trinational standard with NMX-J-674-ANCE and UL 1008)
 - .3 CAN/CSA C22.2 NO. 60947-4-2 - Low-voltage switchgear and control gear - Part 4-2: Contactors and motor- starters — AC semiconductor motor controllers and starters (Binational standard with UL 60947-4-2)
 - .4 CAN/CSA C60044-1-, Instrument Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2, Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches 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 the Province of Ontario, Canada.
 - .1 Indicate on drawings:
 - .1 Make, model and type.
 - .2 Electrical ratings including Voltage, Amperage, number of poles
 - .3 Single line diagram showing controls and relays.
 - .4 Type of enclosure, dimensions and mounting method.
 - .5 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.

- .2 Test control.
- .3 Manual control.
- .4 Automatic shutdown.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.
- .3 Detailed instructions to permit effective operation, maintenance and repair.
- .4 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.

1.5 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 transfer switches from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of 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 Automatic load transfer equipment to:
 - .1 Monitor voltage on phases of normal power supply.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

- .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
- .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.2 MATERIALS

- .1 Instrument transformers: to CAN/CSA C60044-1
- .2 Contactors: to CSA C22.2 NO. 60947-4-2

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT

- .1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1
- .2 Two-3-pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated, with CSA enclosure.
- .3 Rated: 120/208 V, 60Hz, amperage as indicated on drawings, 3-phase, 4 wire, solid neutral.
- .4 Main contacts: silver surfaced, protected by arc disruption means.
- .5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .6 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.
- .7 Fault withstand rating: 25 kA symmetrical for 3 cycles.
- .8 Lever to operate switch manually when switch is isolated.
- .9 Neutral bar, solid rated: amperage as indicated on drawings.

2.4 CONTROLS

- .1 Selector switch -4 position "Test", "Auto", "Manual", "Engine start".
 - .1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
 - .2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
 - .3 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
 - .4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.
- .2 Control transformers: dry type with 120 V secondary to isolate control circuits from:

- .1 Normal power supply.
- .2 Emergency power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
 - .1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
 - .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 s.
 - .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s delay.
 - .4 Time delay on retransfer from standby to normal power, adjustable 20 s to 10 minutes.
 - .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20 s intervals to 10 minutes.
 - .6 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

2.5 ACCESSORIES

- .1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
- .2 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.
- .3 Instruments:
 - .1 Digital true RMS, indicating type 1 % accuracy, flush panel mounting:
 - .1 Voltmeter: ac, scale 0 to 650 V.
 - .2 Ammeter: ac, scale 0 to 600 A.
 - .3 Frequency meter: scale 55 to 65 Hz.
 - .4 Selector buttons for Voltages and Amperes – “Phase A”, “Phase B”, “Phase C” and Average
- .4 Potential transformers - dry type for indoor use:
 - .1 Ratio: 208 to 120.
 - .2 Rating: 208 V, 60Hz, BIL 25 kV.
 - .3 Accuracy rating: 1%.
- .5 Current transformers - dry type for indoor use:
 - .1 Ratio: 400 to 5.
 - .2 Rating: 208 V, 60Hz, BIL 25 kV.
 - .3 Accuracy rating: 1%.
 - .4 Positive action automatic short- circuiting device in secondary terminals.
- .6 Manual bypass and isolator: to normal supply.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 4 nameplates.
 - .2 For meters, indicating lights, minor controls: use size 3 nameplates.

2.7 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of DCC Representative.
- .2 Notify DCC Representative 5 days minimum in advance of date of factory test.
- .3 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .3 Check voltage sensing and time delay relay settings.
 - .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.
 - .4 In-phase monitor operation.

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 transfer switches installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Locate, install and connect transfer equipment as indicated.
- .2 Check solid state monitors and adjust as required to ensure correct operation.
- .3 Install and connect battery and remote alarms.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .7 Repeat, at 1 hour intervals, 4 times, complete test with selector switch in each position, for each test.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 SUMMARY

- .1 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy transient voltage surge suppressors. The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B and C environments (as tested by ANSI/IEEE C62).

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 (prior to repeal 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 (most recent edition)
 - .9 Canadian Standards Association

1.3 ENVIRONMENTAL REQUIREMENTS

- .1 The operating temperature range shall be -40° to 70° C (-40° to 160° F).
- .2 The unit shall be capable of operation up to 13,000 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 let through voltage for each waveform listed, UL1449 latest revision, latest edition, suppressed voltage ratings, dimensions showing construction, lifting and support points, enclosure details, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.
- .2 Submit product data for all components and accessories.
- .3 Manufacturer's Installation Instructions: 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 UL1449 latest edition, latest revision, and CSA standards.

- .6 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and A1 (ringwave) tested in accordance with ANSI/IEEE C62.45.
- .7 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds 40 dB at 100 kHz.
- .8 For retrofit mounting applications, provide electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
- .9 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.
- .10 Provide separate pricing for surge protection devices.

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 period of thirty (30) years from the date of substantial completion of service and activation of the system to which the suppressor is attached. Additionally, the warranty shall state that during the applicable warranty period any SPD which fails due to any transient surge activity, including lightning, shall be repaired or replaced by the manufacturer without charge. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
- .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, not just various components, such as modules only.
- .3 Provide electrically operated equipment specified in this Section that is listed and labeled.

1.6 MANUFACTURER QUALIFICATIONS

- .1 The SPD's shall be manufactured in North America by a manufacturer 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. Manufacturers requesting product approval must meet or exceed the written specification contained herein. Manufacturers requesting approval must receive written verification of product acceptance by the specifying the DCC Representative 10 days prior to the bid date.

Part 2 Products

2.1 PERFORMANCE

.1 General

1. The SPD shall be certified to CSA Standards and to UL's 1283 and UL's 1449 standards (latest edition, latest revision), and not merely the components or modules. All SPD's shall be Type 1 for use in Type 1 and Type 2 locations.
2. The TVSS 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 surge suppression devices through one source from a single manufacturer.
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 277 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. All SPD's shall be Total Protection Solutions. No unit will be accepted as an "approved equal" unless it meets the warranty, strength, safety features, IEEE let-through levels, modes of discrete suppression circuitry, fusing, independent third party per mode surge testing, and all other requirements of this specification.
7. If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a 200kA symmetrical fault current with 600 VAC applied.
8. Each design configuration shall have the maximum single pulse surge current capacity per mode verified through testing at an independent, nationally recognized test laboratory. To be considered for approval, the manufacturer must submit a test report on a unit which was tested with internal over current fusing in place. The test shall include a 1.2 X 50 µsec 6000V open circuit voltage waveform and an 8 X 20 µsec 500A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 X 20 µsec waveform. To complete the test, another identical surge shall be applied to verify the unit's survival. Compliance is achieved if the suppression voltage found from the two impulses does not vary by more than +10%. Test data on an individual module is not acceptable.
9. If the SPD units are installed, either integral to the panel or external to the panel, prior to submittals and approval, and the SPD units as installed do not meet all of the specifications as written, the contractor will remove all rejected SPD units and install approved SPD units per these specifications and the manufacturer's installation manual.
Contractor will be responsible for any and all costs associated with the change order.

.2 Service Entrance Protection

1. The SPD for this location shall be as indicated on project drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL1283 and UL 1449 Third Ed. Type 1 for use in Type 1 or Type 2 locations.
2. The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

ANSI/IEEE C62.41-1991 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)		1273V	1281V	2161V 1295V

C3 Impulse (20kV, 10kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)		1537V	1707V	2470V 1800V

UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
347/600 (3Y600)		1500V	1500V	2500V 1500V

3. The unit shall have a peak surge current of no less than 200kA/phase, 100kA/mode], 8 X 20 us waveform, single impulse, independently verified.
4. Internal Fusing - Over current Protection
 - a. Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more than one MOV per mode.
 - b. For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
 - c. Fusing shall be present in every mode, including Neutral-to-Ground.
 - d. The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
5. The SPD shall come standard with not less than a Thirty Year Warranty, and the warranty shall include unlimited free replacements of the unit if destroyed by lightning or other transients during the warranty period. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
6. The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability and shall have at minimum a NEMA 4 steel enclosure.
7. The SPD shall have an internal audible alarm with mute on the front cover.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the SPD's with the conductors as short and straight as practically possible.
- .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 Distribution and branch panel shall be installed on 30 Amp dedicated circuit breakers or another breaker size as specified by the manufacturer, or, where indicated, shall be wired directly to the main lugs or feed through lugs, or wired directly to the bus bars.
- .4 The installing contractor shall comply with all applicable codes.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Electrical Code, C22.1, Current Edition.
- .2 IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- .3 FCC 47 CFR Part 15, Federal Code of Regulation (CFR) testing standard for electronic equipment
- .4 IESNA LM-79-08, Electrical and Photometric Measurements of Solid-State Lighting Products
- .5 IESNA LM-80-08, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- .6 IESNA TM-15, Luminaire Classification System for Outdoor Luminaires
- .7 IESNA TM-21-11, Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- .8 NEMA SSL 1-2016, Electronic Drivers for LED Devices, Arrays, or Systems.
- .9 NEMA SSL 3-2011, High-Power White LED Binning for General Illumination
- .10 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base.
- .11 CGSB 31-GP-106M, Coating, Conversion, Iron Phosphate, for Paint Base.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 05 00 - Common Work Results - Electrical and 01 33 00 - Submittal Procedures.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires for review by DCC Representative.
- .3 Shop drawings for LED fixtures must include shop drawings for electronic drivers showing that they comply with Section 2 of this specification section.

Part 2 Products

2.1 LEDS

- .1 All LEDs are to be 4000 K colour temperature,
- .2 Minimum CRI 80%.
- .3 Rated design or mean output and average life:
 - .1 LM80 minimum lumen depreciation to 70% of new to be not less than 60,000 hrs.

2.2 FINISHES

- .1 Baked enamel finish:
 - .1 Conditioning of metal before painting:
 - .1 For paint base, conversion coating to CGSB 31-GP-105Ma, CGSB 31-GP-106M.

- .2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel polyester powder coat aluminum to give smooth, uniform appearance, free from pinholes or defects.
- .3 Reflector and other inside surfaces finished as follows:
 - .1 White, minimum reflection factor 85%.
 - .2 Colour fastness: yellowness factor not above 0.02 and after 250 hour exposure in Atlas fade-ometer not to exceed 0.05.
 - .3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
 - .4 Gloss not less than 80 units as measured with Gardner 60° gloss meter.
 - .5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.
 - .6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

2.3 LUMINAIRES

- .1 Refer to Luminaire Schedule on drawings for luminaire types and descriptions

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated on drawings.
- .2 In all locations where equipment may interfere, install fixtures to suit and to the satisfaction of the DCC Representative only after duct work and equipment have been installed.
- .3 Provide and install lamps as indicated and specified.
- .4 Verify correct operation of all LEDS, electronic drivers, and fixtures after 100 hours burning time, replace or repair all defective items.

3.2 LUMINAIRE SUPPORTS

- .1 Support luminaires from the building structure, anchors to be able to support two times fixture weight.
- .2 Mount ceiling luminaires to surface mounted junction box, wire to be in surface mounted conduit between boxes.

3.3 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.

3.4 WIRING

- .1 Connect surface mounted fixtures from outlet box (except in wet well, mount explosion proof fixtures as required by manufacturer).
- .2 Connect fixtures to circuits as indicated.

- .3 Wiring temperature rating to suit fixture listed requirements.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V)
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 26 53 00 – Exit Signs

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No.141, Emergency Lighting Equipment

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 emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

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 emergency lighting 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.
- .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 a clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting 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 and in accordance with Section 01 74 19 - Waste Management and Disposal.

- .5 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 WARRANTY

- .1 For batteries in this Section 26 52 13.13 - Emergency Lighting, 12 months warranty period is extended to 120 months.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 24 V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit or remote mounted, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 6 W, minimum.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white enamel.
- .13 Auxiliary equipment:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 AC input and DC output terminal blocks inside cabinet.
 - .4 Shelf.
 - .5 Cord and single twist-lock plug connection for AC.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: in accordance with manufacturer's recommendations.

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 emergency lighting installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

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 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.

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 printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 61 00 – Common Product Requirements.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 STANDARD UNITS

- .1 Models as per Lighting Schedule on Drawings.
- .2 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .3 Housing: extruded aluminum housing, satin white finish.
- .4 Face and back plates: extruded aluminum.
- .5 Lamps: LED 100,000 hours.
- .6 Operation: designed for over 100,000 hours of continuous operation without relamping.
- .7 Pictogram: Green on White 'Running Man'.

2.2 DESIGN

- .1 Universal mounting.
- .2 Single or double face as shown on Drawings.
- .3 Arrow: Directional arrows as required and shown on drawings.

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, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to dedicated exit light circuits. Provide breaker locks for each of these breakers.
- .3 Ensure that exit light circuit breaker is locked in position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning & Waste Management.
- .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 WORK

- .1 Section 21 13 13 – Wet Pipe Fire Suppression Sprinklers.
- .2 Section 26 05 21 – Wire and Cables 0-1000 V.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CAN/ULC S524-2006-AM1, Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525-2007, Audible Signal Appliances for Fire Alarm.
- .3 CAN/ULC-S526-2007, Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527-2011, Control Units, Fire Alarm.
- .5 CAN/ULC-S528-2005, Manual Pull Stations.
- .6 CAN/ULC-S529-2009, Smoke Detectors, Fire Alarm.
- .7 CAN/ULC-S530-M91, Heat Actuated Fire Detectors, Fire Alarm.
- .8 CAN/ULC-S531-2002, Smoke Alarms.
- .9 CAN/ULC-S536-2004, Inspection and Testing of Fire Alarm Systems.
- .10 CAN/ULC-S537-2004, Verification of Fire Alarm Systems.
- .11 OBC, Ontario Building Code, Current Edition.
- .12 Canada Labour Code.

1.3 SCOPE OF WORK

- .1 This contractor shall supply and install all equipment and accessories required for a complete electrically supervised, non-coded, zoned fire alarm system as described herein and shown on the drawings for the New Workshop Building. This includes a new Addressable Fire Alarm Control Panel, initiation and notification circuits, devices, conduits, wiring, underground ducts and wireless transmitter to the central monitoring station.
- .2 On completion of the installation, the manufacturer's representative shall check the system for proper installation and operation of the system and issue an inspection certificate.
- .3 This contractor shall retain an independent qualified contractor to verify the system on the completion of the installation including integrated system testing in accordance with CAN/ULC S537 and S5001. The independent contractor and the technician performing the system verification shall be registered with the Canadian Fire Alarm Association.

1.4 RELATED WORK BY OTHER DIVISIONS

- .1 Equipment supplied and installed by other Divisions, to be wired into the fire alarm system by this contractor shall include:
 - .1 Make Up Air Units, where applicable
 - .2 Electric door strikes
 - .3 Pre-action sprinkler system

- .4 IT room clean agent suppression system
- .5 BAS
- .6 Standby Generating Set
- .7 Hold open devices
- .8 Maglock
- .9 Smoke Dampers
- .2 The following equipment to be supplied and installed under Division 21, to be wired into the fire alarm system by this contractor:
 - .1 Flow switches
 - .2 Pressure switches
 - .3 Tamper Switches

1.5 MATERIALS STANDARD

- .1 All system components to be ULC Listed for use as part of fire alarm systems and be of one manufacturer.

1.6 SYSTEM DESCRIPTION

- .1 Fully supervised, addressable, microprocessor-based, fire alarm system.
- .2 System to carry out fire alarm and protection functions: including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and alarm initiating signals to monitoring agency.
- .3 Zoned, non-coded, single stage.
- .4 Modular in design to allow for a minimum of 25% future expansion.
- .5 System shall have a minimum of one (1) addressable loop with the ability to add additional loop(s).
- .6 System to include:
 - .1 Central Control Unit (CCU) in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.
 - .4 Output circuits.
 - .5 Auxiliary circuits.
 - .6 Wiring.
 - .7 Manual and automatic initiating devices
 - .8 Audible and visual signaling devices.
 - .9 End-of-line devices where required.
 - .10 Local annunciator.
 - .11 Event log memory chip.
 - .12 Historic event recorder.

- .13 Annunciation of fire alarms on the main and remote alpha-numeric annunciators shall be programmed to indicate the pertinent area zone in which it is located. The area zones shall be required and are shown on drawings.
- .14 Provide passive graphic drawings (floor plans) that show the fire alarm area zones and other pertinent items that will speed up the identification of the location of the fire and shorten the response time. Zone identification on the alpha-numeric readout, and passive graphic drawings must be identical. Passive graphic drawing to be mounted behind a clear acrylic shield in a brushed aluminum frame. Size graphic to suit wall space and the approval of the DCC Representative. Allow for correcting the graphic wording and the panel programming to suit the new layout after the approval of the DCC Representative and the local authority having jurisdiction.
- .15 The equipment and devices to be provided shall be compatible with the existing Siemens system on the base.

1.7 REQUIREMENTS OF REGULATORY AGENCIES

- .1 System components: Listed by ULC and comply with applicable provisions of the National Building Code, Ontario Building Code and Local Building Code, and meet requirements of local authority having jurisdiction.

1.8 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Electrical General Provisions.

1.9 SYSTEM VERIFICATION AND SUBMITTALS

- .1 At the completion of the installation, provide the following letters of certification:
 - .1 Manufacturer to submit (by way of the contractor) to the DCC Representative the following:
 - .1 Copy of inspection technician's report showing location of each device and certifying test results of each device.
 - .2 A signed certificate stating that system has been installed and is operating satisfactorily and meets all Codes and Standards as listed above.
 - .2 Contractor to submit the following:
 - .1 A signed certificate by the Owner and Contractor stating that the Owner has been instructed as to the operation and configuration of the system and maintenance procedures.
 - .3 Both letters of certification shall be on company letterhead and signed by an authorized officer of the company. Each letter shall indicate the following:
 - .1 The name of the system
 - .2 The name of the facility
 - .3 The correct address of the facility
 - .4 A statement that the system has been installed and that it operates in accordance with the drawings and specifications and that the system was found to be in proper operating conditions
- .2 Manufacturer shall test complete system at the end of their twelve (12) month guarantee period and submit to the DCC Representative, results in the form of a signed certificate.

1.10 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 26 05 00 – Electrical General Provisions.
- .2 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data – illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.
 - .5 Copies of all System Verifications and Submittals documents.

1.11 MAINTENANCE MANUALS

- .1 Provide maintenance materials in accordance with Section 26 05 00 – Electrical General Provisions.
- .2 Include:
 - .1 Provide a list of recommended spare parts. In the case of a standard spare kit being provided, the contents of the spare kit shall be listed.

1.12 MAINTENANCE

- .1 Provide one (1) year's free maintenance with two (2) inspections by manufacturer during warranty period. Inspection tests to confirm to CAN/ULC-S536. Submit inspection report to Owner. The start of the guarantee period is as specified in Section 26 05 00 – Electrical General Provisions.

1.13 TRAINING

- .1 Arrange and pay for on-site training and demonstrations by fire alarm system manufacturer to train operational personnel in use and maintenance of fire alarm system. Allow for a sufficient time period of training (minimum four (4) hours).
- .2 System manufacturer shall provide qualified training technicians to give instruction and/or training to the operating and maintenance personnel in all aspects of the system controls, operations and minor troubleshooting.
- .3 Instructions to operating and maintenance personnel: The manufacturer shall provide the services of competent instructors who will provide full instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be oriented toward the system installed rather than being a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC Listed and labeled and supplied by single manufacturer.

2.2 SYSTEM OPERATION: SINGLE STAGE – SIGNALS ONLY

- .1 Actuation of any alarm initiating device to:
 - .1 Cause electronic latch to lock-in alarm state at the Fire Alarm panel.
 - .2 The red alarm LED's in the control panel and annunciator panel(s) shall be turned "ON"
 - .3 Indicate zone of alarm at Fire Alarm control panel annunciator and the remote annunciator panel(s) using zone LED's and/or on the alpha numeric displays.
 - .4 Cause audible signaling devices to sound continuously and visual device to flash continuously throughout building, at the Fire Alarm control panel and at the remote annunciator panel(s).
 - .5 Activate the common alarm contact and transit signal to the approved monitoring agency.
 - .6 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
 - .7 Cause the operation of smoke control dampers.
 - .8 Cause fire doors and smoke control doors, if normally held open, to close automatically, where applicable.
- .2 Acknowledging alarm: indicated at Fire Alarm panel.
- .3 Audible signal devices shall continue to sound during the alarm conditions until manually silenced.
- .4 Possible to silence signals by "alarm silence" switch at Fire Alarm panel, after 60 second period of operation.
- .5 Silencing of the signals shall cause the "Alarm Silenced" indicator LED to light. A subsequent alarm shall cause this indicator to extinguish and all audible device to sound again.
- .6 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .7 Actuation of supervisory devices to:
 - .1 Cause electronic latch to lock-in supervisory state at Fire Alarm panel.
 - .2 Indicate respective supervisory zone at Fire Alarm panel and the remote annunciator panel(s) using zone LED's and/or on the alpha numeric display.
 - .3 Cause audible signal at central control unit and remote annunciator panel(s) to sound.
 - .4 Activate common supervisory sequence.
 - .5 Activate the common trouble contact and transmit trouble signal to the approved monitoring agency.
- .8 Resetting alarm device not to return system indications/functions back to normal until control unit has been reset.
- .9 Trouble on system to:
 - .1 Indicate circuit in trouble at central control unit and at remote annunciator panel(s).
 - .2 Activate "system trouble" indication, buzzer and common trouble sequence.
Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
 - .3 The following conditions shall be monitored:
 - .1 Open circuit fault in the field wiring of an addressable loop, addressable detection or signal module, or a short on an addressable loop or signal circuit

- .2 Failure of a supervised indicator on the remote annunciator or open or short on the wiring to the annunciator
- .3 Disconnection or failure of the battery pack
- .4 A ground fault condition on a field wire
- .5 Failure of the main 120VAC power supplied to the panel
- .6 Removal or malfunction of any addressable field device or any required panel module or component.
- .10 Trouble on system: suppressed during course of alarm.
- .11 Trouble condition on any circuit in system not to initiate alarm conditions.
- .12 Transmit trouble signal to the approved monitoring agency. The owner is responsible for hiring the monitoring agency. This contractor shall provide all required equipment and connections for monitoring of the system.
- .13 Control Switches
 - .1 Reset Switch shall clear the panel of alarm or supervisory conditions once the field device is restored. Also shall perform lamp test function.
 - .2 Signal Silence shall silence the audible signals during the alarm. Switch shall be inhibited for one (1) minute from start of the alarm.
 - .3 Acknowledge Switch shall silence panel alarm and remote buzzer on annunciator.
 - .4 Fire Drill Switch allows for testing of Fire Alarm.
 - .5 Lamp Test Switch shall perform lamp test function of all indicator LEDs automatically on panel.
- .14 Additional System Parameters
 - .1 The system shall be completely field programmable through the use of a laptop computer connected temporarily for this purpose. Programming shall create a project specific file that may be copied to disk and kept for permanent record.
 - .2 Access to the system shall be password protected to 3 levels. Program fields (Example: Device Bypass, Set Time / Date, etc.) must be user selectable to any Command access level.
 - .3 The system shall contain four queues for Alarm, Supervisory, trouble and monitoring with LED indicators and selector keys
 - .4 The system shall contain a two history log of events; one for alarm related events and one for all other events. The authorized operator may view at any time. The "Previous Event" and "Next Event" controls on the panel shall be used to view the events currently showing on the panel LCD display.
 - .5 The addressable communication and signal circuits must be configurable for either Class A (DCLA or DCLC circuits as referenced in ULC S524) or Class B wiring.
 - .6 Panel to have two spare configurable keys and LED indicators for use to be determined at time of installation

2.3 SUPERVISION

- .1 The alarm activation of any device shall not prevent the subsequent alarm operation of any other device.
- .2 Provide independently supervised and independently fused indicating appliance circuits for alarm bells and strobes. Quantity as shown on the drawings.

- .3 All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- .4 Each independently supervised circuit shall include a discrete LCD "Trouble" message to indicate type of problem condition per circuit.
- .5 The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel. A green "Power On" LED shall be displayed continuously while incoming power is present.
- .6 The system batteries shall be supervised so that disconnection of a battery shall be audibly and visually indicated at the control panel. A "Depleted Battery" message shall indicate when standby operation has exceeded battery capacity.
- .7 The System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected from the C.P.U. the system trouble indicator shall illuminate and audible trouble signal shall sound.

2.4 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Suitable for DCLA communication style: to CAN/ULC-S524.
 - .2 The CCU is to monitor and control the entire system and allow control of all system components connected to the system. The CCU shall be of modular design and shall contain the Central Processing Unit (CPU) with the operating software and non-volatile programmed memory. The CPU shall be used to process all system information.
 - .3 The CCU shall be complete with a four (4) line by twenty 20 character LCD alphanumeric display and keypad. All components shall be fully operational while the system is operating on the standby batteries. Keypad shall be membrane style. LCD display shall be back-lit for high contrast visual clarity. In normal (non-alarm) mode, the display shall show the time, date, system condition and user definable message.
 - .4 Individual zone LED's for each alarm initiating and trouble indicating (supervisory) zone plus a minimum of 25% spare capacity for future zones.
 - .5 All events are to be logged automatically in the system for future review. Charge-of-status, alarm and fault messages along with the time of day and date shall be logged. This is accomplished through using an internal memory log.
 - .6 The CPU electronics shall be microprocessor-based. All system functionally and job specific data shall be stored in non-volatile memory and shall survive a complete power failure intact. All operating software shall be executed from random access memory (RAM) to allow password protected field editing. The CPU shall have the capacity to monitor the number of addressable points required for this project plus 25% spare capacity.
 - .7 System shall contain the quantity of audible/visual signal circuits as indicated on the drawings with option for additional signal circuits. Each signal device circuit shall not be loaded to more than 80% capacity.
 - .8 The CPU must incorporate circuitry to continuously monitor the communications and data processing cycles of the microprocessor. On CPU failure, an audible and visual trouble signal shall initiate and provide a remote trouble monitoring station.
 - .9 The CPU shall be equipped with software routines to provide event initiated program (EIP) whereby the receipt of an alarm or supervisory trouble condition may be programmed to operate any or all of the system's control points. EIP actions for life safety functions shall be retained in the non-volatile PROM memory for reliability. The

CPU shall also be capable of reprogramming these EIP functions in the field and retaining the changes in the RAM memory until a new set of PROM are programmed.

- .10 The control unit shall have a minimum of one (1) analog loop base, connected in a Class A Style configuration. The CCU shall be able to process and evaluate incoming signals from addressable devices such as automatic detectors, manual pull station, supervisory valves, etc. Each loop shall be capable of communicating with up to 99 addressable sensor devices and 99 monitor output devices (198 points per loop).
- .11 The CCU shall be capable of supporting up to sixteen (16) conventional hardwired adder modules (any combination of signal, detection or relay modules) and/or four (4) analog loops.
- .12 Adder (expansion) modules may include:
 - .1 Single Loop modules identical in performance to the module integral to the CCU.
 - .2 Dual Loop modules with two (2) analog Loops identical in performance to the module integral to the CCU.
 - .3 Hardwired Loop controller module allowing sixteen (16) additional conventional hard wired adder modules to be supported.
 - .4 Adder Hardwired Modules may include
 - .1 Eight (8) Class B or four (4) Class A initiating circuits
 - .2 Four (4) signaling (indicating) circuits.
 - .3 Eight (8) relay circuits
- .13 Each addressable line module is to have its own microprocessor based circuit, working independently from the central processor board located in the control unit and operating independently from each other.
- .14 All addressable circuits shall be monitored against open circuits, ground faults and shorts. Any malfunctions in any circuit will result in an indication of a trouble condition of this address location at the Control Panel while all other addresses continue operating normally.
- .15 Should a detection device respond with either an alarm or trouble condition, its location must be displayed along with its user text of the alpha numeric display. For maintenance purposes, the panel shall have the ability to display the address information of the device in alarm/trouble condition.
- .16 Auxiliary relays shall be plug-in type with dust cover and supervised against unauthorized removal using a common trouble circuit. Shall come complete with individual bypass switch.
 - .1 Contacts: 3.0 A, 120 VAC, for functions such as release of door holders or initiation of fan shut down.
 - .2 Contact terminal size capable of accepting 22-12 AWG wire.
- .17 The system shall be capable of logging and storing 120 events in an alarm log and 120 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and data of that event's occurrence.
- .18 Provide a general evacuation switch in the control panel to provide the fire department the option of causing a general alarm.
- .19 Transmit alarm, trouble and indicate zone of alarm to monitoring agency.
- .20 CCU shall have visual indicators for the following common control functions:
 - .1 AC Power
 - .2 Alarm

- .3 Supervisory
- .4 Monitor
- .5 Trouble
- .6 Disable
- .7 Ground Fault.
- .21 CCU shall have common control keys/buttons and visual indicators for:
 - .1 Reset
 - .2 Alarm
 - .3 Signal Silence
 - .4 Trouble Silence
 - .5 Fire Drill
 - .6 Two (2) custom programmable key/button and visual indicators.
- .22 Cabinet shall be designed for the installation of the CCU, power supplies, batteries, all input and output modules, relay modules and required adder (expansion) modules.
- .23 Cabinet shall be constructed of minimum 16 Gauge cold rolled steel with powdercoat finish. Provide trim ring for recess (flush) mounting.
- .24 Cabinet shall have a universal CAT-30 lock and key assembly and a removable door.
- .25 The equipment and devices to be provided shall be compatible with the existing Siemens system on the base.

2.5 POWER SUPPLIES

- .1 120 V, 60 Hz emergency power as primary source of power system. Power provided by dedicated circuit.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions, a fault in the battery charging circuit, a short or open in battery leads shall activate the common trouble sequence and the standby power trouble indicator.
- .6 Standby batteries shall be sealed, gel cell type, maintenance free with minimum expected life of 10 years. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a full load mode for a period of twenty-four (24) hours with at least thirty (30) minutes of alarm indication at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in 12 hours.
- .7 All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
- .8 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.6 INITIATING / INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration (or other existing configuration, if different) to Fire Alarm Panel.
- .2 Loss of one zone will not affect the full operation of all remaining zones. Line isolation modules shall be provided for all zones not on a dedicated loop.
- .3 Alarm receiving circuits (active and spare) shall be compatible with smoke detectors and open contact devices.
- .4 Actuation of alarm initiating device shall cause the system to operate as specified in "System Operation".
- .5 Receiving circuits for supervisory, N/O devices. Devices shall be wired in DCLA configuration to Fire Alarm panel.
- .6 Actuation of supervisory initiating device shall cause the system to operate as specified in "System Operation".

2.7 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in Class A configuration.
 - .1 Signal circuits' operation to follow system programming; capable of sounding bells with temporal pattern and of operating strobes. Each signal circuit: rated at 2 A, 24 VDC, fuse protected from overloading/overcurrent.
 - .2 The central control unit shall be capable of coding main panel node notification circuits in Temporal pattern.
 - .3 The central control unit shall synchronize specific strobe lights designed to accept a specific "synchronization pulse."
 - .4 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.8 AUXILIARY CIRCUITS

- .1 Auxiliary contacts shall be provided for control functions.
- .2 Actual status indication (positive feedback) from controlled device
- .3 Alarm or supervisory trouble on the system shall cause the operation of programmed auxiliary output circuits.
- .4 Upon resetting the system, auxiliary contacts shall return to normal or shall operate as pre-programmed.
- .5 Fans shall be stagger-started upon system reset. Provide a timing circuit to separately start each fan or set of fans connected to auxiliary contact on system. Timing circuit shall be controlled by Fire Alarm panel.
- .6 Auxiliary circuits: rated at 2 A, 24 V DC or 120 V AC, fuse-protected.

2.9 WIRING

- .1 Solid tinned copper, annealed conductors with coded PVC insulation, and with overall red PVC jacket. Cables shall be CSA Certified, ULC Listed, 300 Volt, 105°C.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

- .3 To signal circuits: 14 AWG minimum and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 Provide for resistance in wire of not more than 50 ohms for audible signal circuits, 12 AWG minimum.
- .6 The Voltage drop on ANY signal circuit shall not exceed 10%.
- .7 Risers and trunk connections: Mineral Insulated Copper-Clad (MICC), shielded twisted pairs, 2-hour fire-rated, configured to eliminate interference and cross-talk.
- .8 All wiring between buildings shall also be 2-hour fire-rated MICC cables.
- .9 All analog Loop wiring shall be via unshielded twisted pair with maximum of 40 ohms loop resistance and maximum 0.5 microfarad capacitance.

2.10 AUTOMATIC ALARM INITIATING DEVICES

- .1 Setting an alarm initiating device shall be by a physical means. Use of rotary dial switches or dual in-line pin (DIP) switches are acceptable. Devices that use electronic addressing or require the use of special programmers will not be accepted
- .2 Addressable heat detectors: fixed temperature type shall be rated 135°F, 57°C.
- .3 Addressable thermal fire detectors: combination fixed temperature and rate of rise type. Non-restorable fixed temperature elements. Self-restoring rate of rise. Fixed temperature shall be 57°C. Rate of rise shall be 8.3°C per minute using a dual thermistor circuit.
- .4 Addressable duct smoke detector shall be photoelectric type with sampling tubes and protective housing. Lengths of sampling tubes as required.
 - .1 Plug-in type detector with fixed base.
 - .2 Complete with remote LED indicating light mounted on underside of adjacent ceiling or as directed by the DCC Representative.
 - .3 Detector address to be set on detector base in field.
- .5 Addressable smoke detector: Photoelectric type, plug-in type with fixed base. Wire-in base assembly shall have integral continuously lit red LED when in alarm mode. The smoke detector shall be capable of communicating its status (i.e. alarm, "dirty sensor") and to adjust its parameters from the CCU.
- .6 Addressable point modules for use with normally open conventional initiating devices that are required to be addressable. Each Module shall provide one address and shall be connected to an addressable loop of the fire alarm system for monitoring. Module address to be set on the unit in the field.

2.11 MANUAL ALARM INITIATING (PULL) DEVICES

- .1 Addressable manual alarm pull station shall be break glass type on wall mounted or recessed outlet box. Non-coded single pole with normally open contact for single stage operation. Addressable type. Maximum pull force required to operate of 22.2 N.
- .2 Enclosure shall be aluminum with red powdercoat finish.
- .3 Address of pull stations to be set on the back of the back of the device.

2.12 AUDIBLE/VISUAL ALARM SYSTEM DEVICES

- .1 Provide horns, bells and strobes as indicated on drawings.

- .2 Mini-horns shall not exceed 100 dB at 3 metres, flush mounting, red colour, 24 V DC with temporal pattern signal and three volume selections.
- .3 10" Bells shall be minimum 90dB at 3 metres while 6" Bells shall be minimum 86dB at 3 metres, surface mounted, red colour, 24 VDC with temporal pattern signal.
- .4 Strobes shall be solid state, flashing, red, 24 VDC, with word "FIRE" inscribed on polycarbonate lens.
- .5 Solid state circulating with Zenon tube to produce 8000 peak candlepower at one flash per second with field selectable candela settings from 15 to 185 cd. Provide candela settings as indicated on drawings.
- .6 Designed for surface mounting on ceiling or walls as indicated.
- .7 Provide wire guards where indicated.
- .8 Strobes shall be synchronized.
- .9 Bells, horns and strobes shall be installed on a separate notification appliance circuits.

2.13 GRAPHIC ANNUNCIATOR

- .1 Graphic annunciator shall have minimum dimensions of 900 mm x 900 mm.
- .2 Graphic annunciator to be passive type, located at building entrance, behind plexiglass, hinged, completed with lockable front.
- .3 Graphic to include building outline, floor plan, stairs, entrances, exits, "You Are Here", north arrow and fire alarm zones.

2.14 'AS BUILT' RISER DIAGRAM

- .1 Fire alarm system riser diagram shall be mounted in a glazed frame on black lamincoid sheet with beveled edges, white lettering and designations, minimum size 600 x 600 mm. Riser shall be mounted beside the Fire Alarm Control Panel.

2.15 ANCILLARY DEVICES

- .1 Remote relay unit to initiate fan shutdown, where applicable.

2.16 FAULT ISOLATION MODULE

- .1 On the addressable loop, the fault isolation module shall provide isolation of short-circuited sections of the addressable loop, preventing the entire loop from becoming inoperable and allowing addressable devices and modules in the non-short-circuited sections to continue to function properly.

2.17 END OF LINE DEVICES

- .1 End of Line Devices shall be sized as per the manufacturer's recommendations. Mount devices within outlet boxes separate from those for other devices at the locations indicated, and install less than 1800 mm above finished floor level, measured from the centre of the end-of-line device, and located beyond the last device in the circuit or terminated in a control unit or transponder. Fire alarm and detection system components shall be accessible for purposes of inspection or maintenance. Provide on the coverplate for each such device an approved nameplate, engraved "END-OF-LINE DEVICE" or with an approved symbol. Provide red lamincoid plate with white 6mm letters identifying zone.

2.18 ACCEPTABLE MANUFACTURER

- .1 The equipment and devices to be provided shall be compatible with the fire alarm system on the base.

Part 3 Execution

3.1 INSTALLATION SCHEDULE

- .1 System must be complete, approved and operational before the project completion date or the contractor will be held accountable for costs associated with late opening.
- .2 Do not commence any item of work affecting any part of an existing system until all necessary materials are on site for that item of work. Having started such an item, carry out work continuously until that portion of the system is restored to full operation.

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install all components per manufacturer's recommendations, and co-ordinate with the installation schedule.
- .3 Where required, install fire alarm remote annunciator panel(s) so that the alphanumeric displays are between 1500 mm and 1700 mm AFF.
- .4 Install manual alarm pull stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Local duct type detectors in straight portions of ducts
- .6 Connect alarm circuits to main control panel.
- .7 Install horns, bells and visual signal devices and connect to signaling circuits.
- .8 Connect signaling circuits to main control panel.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring, where applicable.
- .10 Install door-releasing devices, where applicable.
- .11 Install remote relay units to control fan shut down, where applicable.
- .12 Sprinkler system. Provide addressable point modules and connect alarm and supervisory switches. Connect circuit(s) to control panel.
- .13 Splices are not permitted.
- .14 Provide all necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and FACP, as required by equipment manufacturer.
- .15 Provide outlet boxes of ample size for clearance to wiring connections. Provide recessed boxes for manual pull stations complete with plaster rings.
- .16 Knock-out type back boxes will NOT be permitted.
- .17 Ensure that wiring is free of opens, shorts or grounds, before system testing and hand-over.
- .18 Identify circuits and other related wiring at central control unit, annunciators and terminal boxes.

3.3 WIRING INSTALLATION

- .1 Provide all necessary interconnections and remote signal wiring, in accordance with these specifications, the tender drawings, the manufacturer's wiring diagrams, the requirements of the Ontario Electrical Safety Code and the Inspection Authority.
- .2 Provide terminal cabinets complete with terminal blocks for wiring convenience at junction points in the system where recommended by the manufacturer.
- .3 All conductors shall be cut at each station, detector and signaling device and connections shall be made in the approved manner to ensure proper supervision of the wiring. This will require the use of four (4) screws at each device.

3.4 TESTING AND INSPECTION

- .1 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual pull stations, thermal and smoke-actuated detectors and controls, whether or not the equipment was made by the fire alarm system manufacturer. The inspection shall comprise an examination and test of the equipment for the following:
 - .1 That the type of equipment installed is that designated by the specifications.
 - .2 That the wiring connections to all equipment components were done in accordance with all ULC, CSA and Ontario Electrical Safety Code requirements.
 - .3 That all products-of-combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
 - .4 That equipment made by the fire alarm system manufacturer have been installed in accordance with the manufacturer's recommendations and that all alarm-initiating, annunciation and signaling devices of any manufacture have been operated or tested to verify their operation.
 - .5 That supervisory wiring of those items of equipment connected to a supervised circuit are operating and that the wiring meets the requirements of the inspecting authorities.
 - .6 Testing to be done in the presence of and to the satisfaction of the local building inspector and the authorities having jurisdiction.
 - .7 Fire alarm system shall be verified as per CAN/ULC S537 and integrated testing performed in accordance with CAN/ULC S5001.

END OF SECTION

Part 1 General

1.1 ABBREVIATIONS

- .1 GW: Well-graded gravel
- .2 GP: Poorly graded gravel
- .3 GC: Clayey gravel
- .4 SW: Well-graded sand
- .5 SP: Poorly graded sand
- .6 SC: Clayey sand
- .7 CL: Lean clay
- .8 ML: Silt
- .9 CH: Fat clay
- .10 MH: Elastic silt

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C 136/C 136M, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .2 ASTM D 1140, Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No.200) Sieve in Soils by Washing
 - .3 ASTM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - .4 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - .5 ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

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 aggregate materials. Include product characteristics, performance criteria, practical size, finishes, and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Segregation, contamination, and degradation of aggregates during handling and transportation is not permissible.
- .3 Store washed materials or materials excavated from underwater for a minimum of 24 hours to allow for free drainage of water and for materials to reach uniform water content.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate Quality: Sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, and adherent coatings or other deleterious substances.
- .2 Aggregate Classification:
 - .1 Cohesionless materials: To ASTM D 2487
 - .2 Cohesive materials: To ASTM D 2487
- .3 Flat and Elongated Particles of Coarse Aggregate: To ASTM D 4791.
 - .1 Length to thickness ratio equal to or greater than 5:1.
- .4 Fine aggregates satisfying requirements of applicable sections to be one of or a blend of the following:
 - .1 Screenings produced from crushing quarried rock, boulders, gravel or slag.
 - .2 Reclaimed asphalt pavement.
 - .3 Reclaimed concrete material.
- .5 Coarse aggregates satisfying requirements of applicable sections, such as to be one of or a blend of the following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Lightweight aggregate, including slag and expanded shale.
 - .4 Reclaimed asphalt pavement.
 - .5 Reclaimed concrete material.

2.2 SOURCE QUALITY CONTROL

- .1 Inform DCC Representative of proposed source of aggregates and provide access for sampling a minimum 4 weeks before starting production.
- .2 If materials from proposed source do not meet or cannot reasonably be processed to meet specified requirements, then locate alternative source.

- .3 Advise DCC Representative a minimum 4 weeks in advance of proposed change of material source.
- .4 Provide DCC Representative with access to source and processed material for sampling.
- .5 Acceptance of material at source does not exclude it from potential future rejection if it fails to conform to specified requirements, lacks uniformity, or if its site performance is found to be unsatisfactory.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify site conditions as follows:
 - .1 Topsoil:
 - .1 Examine topsoil for clods, rocks, snow, large roots, litter, and toxic substances before proceeding with stripping.
 - .2 Proceed with topsoil stripping, after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 AGGREGATE SOURCE PREPARATION

- .1 Clear, grub, and strip unsuitable surface materials before excavating for aggregate production. Dispose of unsuitable materials using method reviewed by DCC Representative and in accordance with Section 01 74 19 –Waste Management and Disposal.
- .2 Clear, grub and strip area ahead of quarrying or excavate sufficiently to prevent contamination of aggregate by deleterious materials.
- .3 When excavation is completed, dress sides of excavation to nominal 1.5:1 slope. Provide drains or ditches as required to permit for proper drainage.
- .4 Trim off and dress slopes of waste material piles. Leave site in neat condition.
- .5 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.

3.3 PROCESSING

- .1 Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.
- .2 Blend aggregates as required, including reclaimed materials that meet specified requirements in order to satisfy gradation requirements or specified particle shapes.
 - .1 Use methods and equipment reviewed in writing by DCC Representative.
- .3 When operating in stratified deposits use excavation equipment and methods that produce uniform and homogeneous aggregate gradation.

- .4 Screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.

- .1 Use only equipment reviewed in writing by DCC Representative.

3.4 STOCKPILING

- .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by DCC Representative. Do not stockpile on completed pavement surfaces.
- .2 Stockpile aggregates in sufficient quantities to meet project schedules.
- .3 Use stockpile sites that are level, well-drained and have adequate bearing capacity to support the weight of stockpiled materials and handling equipment.
- .4 Except where stockpiled on acceptably stabilized areas:
 - .1 Provide compacted sand base minimum of 300 mm in depth to prevent contamination of aggregate; or,
 - .2 Stockpile aggregates on ground but do not incorporate bottom 300 mm of stockpile into Work.
- .5 Divide different aggregates by strong, full depth bulkheads, or separate each stockpile by a sufficient distance to prevent intermixing.
- .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials in accordance with Section 01 74 19 – Waste Management and Disposal by means acceptable to DCC Representative within 48 hours of rejection.
- .7 Stockpile materials in uniform layers a maximum 1.5 m in depth. Complete and level each layer before placing the subsequent layer.
- .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
- .9 Do not cone piles or spill material over edges of piles. Keep the completed stockpiles neat, regular in form and occupying the smallest possible area.
- .10 Do not use stacking conveyors.
- .11 During winter operations, prevent penetration of ice and snow into stockpile or in material being removed from stockpile.

3.5 CLEANING

- .1 Cleaning: Perform in accordance with Section 01 74 00 - Cleaning & Waste Management.
- .2 Leave aggregate stockpile site in tidy, well-drained condition, free of standing surface water.
- .3 Leave any unused aggregates in neat compact stockpiles in locations directed by DCC Representative.

- .4 Waste Management: Perform in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregates for Earthwork
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 DEFINITIONS

- .1 Rock: Solid material in excess of 0.25 m³. Frozen material not classified as rock.
- .2 Peak Particle Velocity (PPV): Maximum speed or velocity reached by a particle in a medium, such as the ground, as a result of a seismic or vibrational event. It is used to quantify the intensity of ground motion caused by various sources, including earthquakes, explosions, construction activities, or industrial processes. PPV is measured in mm/s.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Regulatory Requirements:
 - .1 Comply with authority having jurisdiction (AHJ) requirements.
- .2 Coordination:
 - .1 Coordinate with Temporary Controls for erosion and sediment control measures.

Part 2 Products
2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Vibration Control:
 - .1 Limit ground vibrations to avoid damage to structures or remaining rock mass.

3.2 ROCK REMOVAL - GENERAL

- .1 Remove rock to alignments, profiles, and cross sections indicated on Drawings.
- .2 Excavate rock to produce uniform and stable excavation surfaces.
- .3 Excavate rock to form level bearing that follows natural strata. Form with sharp steps.
- .4 Prepare rock surfaces to be bond to concrete, by scaling, pressure- washing, and broom cleaning surfaces.
- .5 Excavate trenches to lines, widths, and grades to minimum of 600mm below pipe inverts. Provide recesses for bell and spigot pipes to ensure bearing will occur uniformly along barrel of pipe.

- .6 Remove boulders and fragments which may slide or roll into excavated areas.
- .7 Minimize overbreak and avoid damage to adjacent structures.
- .8 Correct unauthorized rock removal in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling at no extra cost.

3.3 ROCK REMOVAL - MECHANICAL

- .1 Excavate rock using mechanical methods.
- .2 Remove final layers carefully to provide sound and unshattered base for footings and foundations.
- .3 Bedrock removal at this site could be carried out using hoe ramming techniques in conjunction with line drilling on close centres. Provided that good bedrock excavation techniques are used, the bedrock could be excavated using near vertical side walls. Any loose bedrock should be scaled from the sides of the excavation for worker safety.

3.4 CLEANING

- .1 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal and:
 - .1 Rock Disposal:
 - .1 Dispose of removed rock off site.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 16.26 – Rock Removal.
- .2 Section 32 92 19.13 – Mechanical Seeding.
- .3 Section 33 65 73 – Concrete Encased Duct Banks and Manholes.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117-17, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63-(2007)e1 , Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ü) (600 kN-m/m3).
 - .5 ASTM D 1557-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ü) (2,700 kN-m/m3).
 - .6 ASTM D 4318-17, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA-A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 Appendix A – Geophysics GPR International Inc., Letter Report Dated November 19, 2018.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m3 and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1, CAN/CGSB-8.2.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
 - .3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field, clearance record from utility authority, location plan of relocated and abandoned services, as required.
- .3 Samples:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform DCC Representative at least 4 weeks prior to beginning Work, of proposed source of fill, unshrinkable fill materials and provide access for sampling.

1.5 EXISTING CONDITIONS

- .1 Examine GPR report amended to the specifications as Appendix A.
- .2 Buried services:
 - .1 Before commencing work establish location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authorities for locating buried services that may interfere with execution of work.
 - .3 Remove obsolete buried services within 1 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable DCC Representative and authorities having jurisdiction, establish location and state of use of buried utilities and structures. DCC Representative and authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
 - .6 Confirm locations of buried utilities by careful soil hydrovac methods.
 - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .8 Where utility lines or structures exist in area of excavation, obtain direction of DCC Representative before removing or re-routing.
 - .9 Record location of maintained, re-routed and abandoned underground lines.
 - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with DCC Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by DCC Representative.
 - .3 Where required for excavation, cut roots or branches as directed by DCC Representative, minimizing disturbance. Refer to Section 01 35 43 – Environmental Protection, for requirements for cutting of roots.

Part 2 Products

2.1 MATERIALS

- .1 Granular A to OPSS 1010.
- .2 Granular B to OPSS 1010 Type II.
- .3 Sand Bedding for Cable Ducts and/or Cables:

- .1 Natural sand or crushed stone screenings free from clay lumps, cementation, organic and other objectionable material, following gradation limits:
- | ASTM Sieve | Passing |
|------------|----------|
| 5.00 mm | 100 |
| 2.00 mm | 30 - 100 |
| 0.425 mm | 10 - 50 |
| 0.075 mm | 0 - 10 |
- .4 Type 3 fill: selected material from excavation or other sources, approved by DCC Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .5 Unshrinkable fill: proportioned and mixed to provide:
- .1 Maximum compressive strength of 0.4 MPa at 28 days.
- .2 Maximum cement content of 25 kg/m³ with 40% by volume fly ash replacement: to CSA-A3001, Type GU.
- .3 Minimum strength of 0.07 MPa at 24 h.
- .4 Concrete aggregates: to CSA-A23.1/A23.2.
- .5 Cement: Type GU.
- .6 Slump: 160 to 200 mm.
- .6 Hot mix asphalt, HL3 and HL8 to OPSS 1150, PGAC 58-34.
- .7 Topsoil to OPSS 802.

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.
- .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.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Stake out trench routings and obtain approval from DCC Representative prior to beginning works.
- .3 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly in accordance with Section 02 41 13 - Selective Site Demolition.

3.3 PREPARATION / PROTECTION

- .1 Protect existing features.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

- .1 Remove shrubs and vegetation, and other obstructions.
- .2 Strip topsoil along trenching limits.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile along the trench for re-use.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by DCC Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition.
- .2 During backfill operation:
 - .1 Unless otherwise indicated or directed by DCC Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .3 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .4 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore surface.

3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for DCC Representative's review and approval, details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Protection to approved runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

3.8 EXCAVATION

- .1 Remove concrete paving walks and other obstructions encountered during excavation in accordance with Section 02 41 13 - Selective Site Demolition.
- .2 Excavation must not interfere with bearing capacity of adjacent foundations.
- .3 Do not disturb soil within branch spread of trees or shrubs that are to remain where possible.
 - .1 If excavating through roots, clean saw cuts are required in accordance with Section 01 35 43 – Environmental Protection.
- .4 For trench excavation, unless otherwise authorized by DCC Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .5 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by DCC Representative.
- .6 Restrict vehicle operations directly adjacent to open trenches.
- .7 Dispose of surplus and unsuitable excavated material off site.
- .8 Do not obstruct flow of surface drainage or natural watercourses.
- .9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .10 Notify DCC Representative when bottom of excavation is reached.
- .11 Obtain DCC Representative approval of completed excavation.

- .12 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by DCC Representative.
- .13 Install concrete duct banks at minimum 600 mm cover for secondary and 760 mm for primary.
- .14 Correct unauthorized over-excavation as follows:
 - .1 Fill under other areas with Granular B Type II fill compacted to not less than 95% of corrected Standard Proctor maximum dry density.
- .15 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of DCC Representative.

3.9 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698 and ASTM D 1557.
 - .1 Exterior side of perimeter walls: use Granular B Type II fill to subgrade level. Compact to 95% of corrected maximum dry density.
 - .2 Within building area: use Granular B Type II to underside of base course for floor slabs. Compact to [100] % of corrected maximum dry density.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Granular A fill to underside of slab. Compact base course to 100%.

3.10 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Place bedding and surround material in unfrozen condition.

3.11 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 DCC Representative has inspected and approved installations.
 - .2 Inspection, testing, approval, and recording location of underground utilities.
 - .3 Removal of concrete formwork.
 - .4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 1 m.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from DCC Representative.

3.12 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris.
- .2 Replace topsoil.
- .3 Reinstall lawns to elevation which existed before excavation with existing topsoil and mechanical seed.
- .4 Reinstall pavements, curb and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by DCC Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Section 32 11 23 - Aggregate Base Courses.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D6913/D6913M-17, Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sleeve Analysis.
 - .3 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .4 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Ontario Provincial Standards Specification (OPSS).
 - .1 OPSS Muni 1010, Material Specification for Aggregate - Base, Sub-Base, Select Subgrade and Backfill Material.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative quality control inspection and testing results/reports as described in PART 3 of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, stockpile, store and handle materials in accordance with Section 31 05 16 - Aggregate Materials.

Part 2 Products

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Granular B Type II in accordance with OPSS Muni 1010.

Part 3 Execution

3.1 PREPARATION

- .1 Contractor shall submit a sediment and erosion control plan.

3.2 PLACING

- .1 Place granular base after subgrade surface is inspected and approved by DCC Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
 - .1 In parking lot and laneway and without curbs, granular base and sub-base is to extend a minimum of 0.3m beyond the paving limits.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
- .9 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 98% standard proctor maximum dry density in accordance with ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by DCC Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 PROOF ROLLING

- .1 Proof rolling in accordance with the following:
 - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
 - .2 Contractor may request in writing use of non-standard proof rolling equipment from the DCC Representative. Contractor must provide justification for use of non-standard proof rolling equipment from a certified geotechnical company.
 - .1 The acceptance or rejection of the request by the DCC Representative does not alleviate the contractor's responsibility to provide acceptable proof rolling and/or compaction.
 - .3 Proof roll at level in sub-base as indicated.
 - .1 If non standard proof rolling equipment is approved, Contractor to have certified geotechnical company determine level of proof rolling, with the approval of the DCC Representative.
 - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Notify DCC Representative immediately.
 - .2 Remove sub-base and subgrade material to depth and extent as directed by DCC Representative.
 - .3 Backfill excavated subgrade with sub-base material and compact in accordance with this section.
 - .4 Replace sub-base material and compact.
- .2 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost to DCC or the Owner.

3.5 QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 Laboratory testing shall be performed on the sub-base material to determine the optimum moisture content (OMC) and maximum dry density (MDD), required for compaction testing, and in accordance with Section 31 05 16 - Aggregate Materials.
- .3 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.
- .4 Minimum testing frequency:
 - .1 Earth embankments, granular base, granular subbase, and granular shoulders:
 - .1 Every lift, 3 test per location (access to hangar, access road to tank, along duct bank from Building 667 to Building 526)

- .2 Structure backfill and sewer and water bedding, embedment, cover, or backfill material, granular:
 - .1 Every lift, and every 20m of placement, minimum 2 tests per utility trench.
- .5 Submit compaction test results at the completion of each day to DCC Representative for review.
- .6 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .7 All costs associated with quality control inspection and testing will be borne by the Contractor.
- .8 DCC Representative may conduct own Quality Assurance testing on materials as deemed appropriate at own cost.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.

3.7 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.8 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 32 11 16.01 - Granular Sub-Base

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C136/C136M19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .3 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Ontario Provincial Standard Specification (OPSS).
 - .1 OPSS Muni 1010 Aggregates - Base, Subbase Select Subgrade, and Backfill Material.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative quality control inspection and testing results and reports as described in PART 3 of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, stockpile, store and handle materials in accordance with Section 31 05 16 - Aggregate Materials.

Part 2 Products

2.1 MATERIALS

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Granular A material as per OPSS Muni 1010

Part 3 Execution

3.1 PREPARATION

- .1 Contractor shall submit a sediment and erosion control plan ss per Section 01 35 43 - Environmental Procedures.

3.2 PLACING

- .1 Place granular base after granular sub-base surface is inspected and approved by DCC Representative.
- .2 Construct granular base to depth and grade in areas indicated.
 - .1 In parking lot and laneway without curbs, granular base is to extend a minimum of 300mm beyond the paving limits.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow and ice.
- .5 Begin spreading base material on crown line or on high side of one-way slope.
- .6 Place material using methods which do not lead to segregation or degradation of aggregate.
- .7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 DCC Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.3 COMPACTION

- .1 Ensure compaction equipment is capable of obtaining required material densities.
- .2 Compact to density not less than 98% standard proctor maximum dry density to ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .4 Apply water as necessary during compacting to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by DCC Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 PROOF ROLLING

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
- .2 Contractor may request in writing use of non-standard proof rolling equipment from the DCC Representative. Contractor must provide justification for use of non-standard proof rolling equipment from a certified geotechnical company.
 - .1 The acceptance or rejection of the request by the DCC Representative does not alleviate the contractor's responsibility to provide acceptable proof rolling and/or compaction.
- .3 Proof roll at level in granular base as indicated.
 - .1 If non-standard proof rolling equipment is approved, Contractor to have certified geotechnical company determine level of proof rolling, with the approval of the DCC Representative.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Notify DCC Representative immediately.
 - .2 Remove base, sub-base and subgrade material to depth and extent as directed by DCC Representative.
 - .3 Backfill excavated subgrade with material as directed by DCC Representative.
 - .4 Replace sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
 - .5 Replace base material and compact in accordance with Section 31 05 16 - Aggregate Materials and this Section.
- .6 Where proof rolling reveals defective base, remove defective materials to depth and extent as directed by DCC Representative and replace with new materials in accordance with this section at no extra cost to DCC or the Owner.

3.5 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.6 QUALITY CONTROL

- .1 The Contractor shall be responsible for all quality control inspection, laboratory testing and compaction testing.
- .2 Laboratory testing shall be performed on the granular base to determine the optimum moisture content (OMC) and maximum dry density (MDD), required for compaction testing, and in accordance with Section 31 05 16 - Aggregate Materials.

- .3 All compaction testing must be carried out by a qualified technician, trained in safe operation, transportation and handling of nuclear gauge. Technician performing compaction tests to be on-site during all compaction operations.
- .4 Minimum testing frequency:
 - .1 Earth embankments, granular base, granular subbase, and granular shoulders:
 - .1 Every lift, 3 test per location (access to hangar and access road to tank)
 - .2 Structure backfill and sewer and water bedding, embedment, cover, or backfill material, granular:
 - .1 Every lift, and every 20m of placement, minimum 2 tests per utility trench.
- .5 Submit compaction test results at the completion of each day to DCC Representative for review.
- .6 Contractor shall conduct and submit satisfactory compaction test results to DCC Representative prior to placement of subsequent material. The DCC Representative will not consider payment for placement of any material unless satisfactory quality control test results are submitted by the Contractor.
- .7 All costs associated with quality control inspection and testing will be borne by the Contractor.
- .8 DCC Representative may conduct own Quality Assurance testing on materials as deemed appropriate at own cost.
- .9 Quality assurance inspection or testing by the DCC Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.

3.8 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by DCC Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 31 05 16 – Aggregates for Earthwork

1.2 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mixes.
- .3 ASTM International
 - .1 ASTM C 88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .4 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 302, Construction Specification for Primary Granular Base.
 - .2 OPSS 310, Construction Specification for Hot Mixed Asphalt.
 - .3 OPSS 314, Construction Specification for Untreated Granular, Subbase, Base, Surface Shoulder and Stockpiling.
 - .4 SP 110S13, Amendment to OPSS 1010, Material Specification for Aggregates, Granular A, B, M and Select Subgrade Material.
 - .5 OPSS 1103, Material Specification for Emulsified Asphalt.
 - .6 OPSS 1150, Material Specification for Hot Mixed Asphalt.

1.3 MEASUREMENT AND PAYMENT

- .1 Measure asphalt paving in tonnes of asphalt concrete incorporated into Work.
 - .1 HL 3 – Surface Course approx. 1,185m²
 - .2 HL 8 – Base Course approx. 1,160m²

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, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C 4 weeks prior to beginning Work.
- .3 Samples:
 - .1 Inform DCC Representative of proposed source of aggregates and provide access for sampling 4 weeks prior to beginning Work.
 - .2 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with EPA 832/R-92 and authorities having jurisdiction.
 - .3 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage 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 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregates for Earthwork. Stockpile minimum 50% of total amount of aggregate required before beginning asphalt mixing operation.
- .3 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
- .4 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
- .5 Provide approved storage, heating tanks and pumping facilities for asphalt cement.
- .6 Packaging Waste Management: remove for reuse and return of 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 Aggregates to: SP 110S13.
 - .1 Granular A material as per OPSS Muni 1010.

- .2 Granular B Type II material as per OPSS Muni 1010.
- .3 Select subgrade.
- .2 Prime coat: MTO Primer to OPSS MUNI 1103
- .3 Tack coat: SS-1 to OPSS MUNI 1103

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 asphalt paving in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative 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 DCC Representative.

3.2 FOUNDATIONS

- .1 Foundations for parking lot and laneway to comprise:
 - .1 300 mm compacted thickness of granular A base.
 - .2 300 mm compacted thickness of granular B sub-base
- .2 Construction of granular foundations: OPSS 314.
- .3 Compaction: compact each lift of granular material to 100% maximum density to ASTM D 698. Maximum lift thickness: 150 mm.

3.3 PAVEMENT THICKNESS

- .1 Pavements for parking lot and laneway:
 - .1 Surface course: 40 mm HL3.
 - .2 Base course: 50 mm HL8.

3.4 PAVEMENT CONSTRUCTION

- .1 Application of prime coat: OPSS 302
- .2 Construction of asphalt concrete: OPSS 310

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .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 & Waste Management.
- .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 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .2 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual – April 2022.
 - .1 MPI #32, Traffic Markings Paint, Alkyd.
 - .2 MPI #97, Latex Traffic Marking Paint.
- .3 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS MUNI 710- 2023, Pavement Markings

1.2 MEASUREMENT AND PAYMENT

- .1 Pavement marking measured by lump sum.
- .2 Symbols and letters: measured in lump sum.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location 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 Alkyd Traffic Paint and Markings:
 - .1 To MPI #32, Alkyd traffic marking meeting requirements of ASTM D 4797
 - .2 Colour: to ASTM E 1360, yellow, white and blue in accordance with MPI Architectural Painting Specification Manual

- .2 Latex traffic Paint and Markings:
 - .1 To MPI #97, Latex traffic marking meeting requirements of ASTM D 4797
 - .2 Colour: to ASTM E 1360 yellow, white and blue in accordance with MPI Architectural Painting Specification Manual
- .3 Thinner: to MPI listed manufacturer

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive pavement markings acceptable for product installation in accordance with MPI instructions prior to pavement markings application
 - .1 Visually inspect substrate in presence of DCC Representative.
- .2 Pavement surface: dry, free from water, frost, ice, dust, oil, grease and other deleterious materials.
- .3 Proceed with Work only after unacceptable conditions rectified.

3.2 EQUIPMENT REQUIREMENTS

- .1 Paint applicator: approved pressure type with positive shut-off distributor capable of applying paint in single, double and dashed lines and capable of applying marking components uniformly, at rates specified, and to dimensions as indicated.

3.3 TRAFFIC CONTROL

- .1 Traffic Control in accordance with Section 01 55 26 – Traffic Control.

3.4 APPLICATION

- .1 Pavement markings: reinstate to match existing conditions.
- .2 Unless otherwise approved by DCC Representative, apply paint when air temperature minimum 10 degrees C, wind speed maximum 60 km/h and no rain forecast within next 4 hours.
- .3 Apply traffic paint evenly at rate of 3 m² /L to form minimum 8 mil dry film thickness, in accordance with MPI Architectural Painting Specification Manual "Preparation of Surfaces" and "Application" for "Approved Product" listing.
- .4 Do not thin paint unless approved by Departmental Representative.
- .5 Symbols and letters to dimensions indicated.
- .6 Paint lines of uniform colour and density with sharp edges.
- .7 Thoroughly clean distributor tank before refilling with paint of different colour.

3.5 TOLERANCE

- .1 Paint markings: within plus or minus 12 mm of dimensions indicated.
- .2 Remove incorrect markings.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning & Waste Management.
 - .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 & Waste Management.

3.7 PROTECTION

- .1 Protect pavement markings until dry.
- .2 Repair damage to adjacent materials caused by pavement marking application.

END OF SECTION

Part 1
Part 1 **General**
 General

1.1 **RELATED SECTIONS**

- .1 Section 32 92 23 – Sodding

1.2 **REFERENCES**

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.

1.3 **DEFINITIONS**

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

Part 2 **Products**

2.1 **TOPSOIL**

- .1 Contractor to follow all testing requirements and provide documentation as outlined in Section 01 35 43 Environmental Procedures for all imported fill material.
- .2 Import topsoil for sodded areas: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Contain no toxic elements or growth inhibiting materials.
- .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .3 Consistence: friable when moist.

2.2 **SOIL AMENDMENTS**

- .1 Fertilizer:
 - .1 Complete commercial fertilizer with minimum 65% insoluble nitrogen.
- .2 Sand: washed coarse silica sand, medium to course textured.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Contractor shall submit a sediment and erosion control plan as per Section 01 35 43 - Environmental Protection.
 - .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.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

3.2 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify DCC Representative and do not commence work until instructed by DCC Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after DCC Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement.
 - .1 100 mm for sodded areas.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by DCC Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE

- .1 DCC Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.6 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning & Waste Management.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule sod laying to coincide with preparation of soil surface.
 - .2 Schedule sod installation when frost is not present in ground.

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 sod and fertilizer and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with supplier's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
 - .1 Turf Grass Nursery Sod types:
 - .1 Number One Kentucky Bluegrass Sod: Nursery Sod grown solely from seed of cultivars of Kentucky Bluegrass, containing not less than 50% Kentucky Bluegrass cultivars.
 - .2 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.
 - .3 Number One Named Cultivars: Nursery Sod grown from certified seed.
 - .2 Turf Grass Nursery Sod quality:
 - .1 Not more than 1 broadleaf weed and up to 1% native grasses per 40 m².
 - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
 - .3 Mowing height limit: 35 to 65 mm.
 - .4 Soil portion of sod: 6 to 15 mm in thickness.

- .2 Fertilizer:
 - .1 To Canada "Fertilizers Act" and Fertilizers Regulations.
 - .2 Complete, synthetic, slow release with 65 % of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

- .1 Obtain written approval from DCC Representative of sod at source.
- .2 When proposed source of sod is approved, use no other source without written authorization from DCC Representative.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify DCC Representative and do not commence work until instructed by DCC Representative.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

3.2 SOD PLACEMENT

- .1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by DCC Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

- .1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.
- .2 Start laying sod at bottom of slopes.
- .3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:
 - .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
 - .2 Not less than 3-6 pegs per square metre.

- .3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by DCC Representative.
- .4 Drive pegs to 20 mm above soil surface of sod sections.

3.4 FERTILIZING PROGRAM

- .1 Contractor to develop fertilizing program in order to conform to seeding acceptance requirements in accordance with the ACCEPTANCE section below.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning & Waste Management.

3.6 PROTECTION BARRIERS

- .1 Protect newly sodded areas from deterioration with snow fence on rigid frame as directed by DCC Representative.

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of installation until acceptance.
 - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
 - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm.
 - .3 Maintain sodded areas weed free to 95%.
 - .4 Temporary barriers or signage to be maintained where required to protect newly established sod.

3.8 ACCEPTANCE

- .1 Turf Grass Nursery Sod areas will be accepted by DCC Representative provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots.
 - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
 - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.
- .3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.

3.9 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
- .2 Repair and resod dead or bare spots to satisfaction of DCC Representative.

- .3 Cut grass and remove clippings as directed by DCC Representative

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 – Aggregate Material.
- .2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-18, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-18 Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-18, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C104/A21.4-16, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - .5 ANSI/AWWA C105/A21.5-18, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - .6 ANSI/AWWA C111/A21.11-17, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - .7 ANSI/AWWA C110/A21.10-12, American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
 - .8 ANSI/AWWA C150/A21.50-08, Standard for Thickness Design of Ductile-Iron Pipe.
 - .9 ANSI/AWWA C151/A21.51-17, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - .10 ANSI/AWWA C153/A21.53-11, Standard for Ductile-Iron Compact Fittings.
 - .11 ANSI/AWWA C200-17, Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.
 - .12 ANSI/AWWA C203-15, Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
 - .13 ANSI/AWWA C205-18, Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
 - .14 ANSI/AWWA C206-17, Standard for Field Welding of Steel Water Pipe.
 - .15 ANSI/AWWA C207-18, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
 - .16 ANSI/AWWA C208-17, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
 - .17 ANSI/AWWA C300-16, Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
 - .18 ANSI/AWWA C301-14, Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
 - .19 ANSI/AWWA C303-17, Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
 - .20 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - .21 ANSI/AWWA C504-15, Standard for Rubber-Seated Butterfly Valves.
 - .22 ANSI/AWWA C600-10, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
 - .23 ANSI/AWWA C602-17, Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
 - .24 ANSI/AWWA C651-14, Standard for Disinfecting Water Mains.
 - .25 ANSI/AWWA C800-14, Standard for Underground Service Line Valves and Fittings.
 - .26 ANSI/AWWA C900-16, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.

- .2 ASTM International
 - .1 ASTM A 53/A 53M-18, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A 123/A 123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A 307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .4 ASTM B 88M-18, Standard Specification for Seamless Copper Water Tube (Metric).
 - .5 ASTM C 117-17, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .6 ASTM C 136-14, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C 478M-18, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - .8 ASTM D 698-16, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .9 ASTM D 2310-(2012), Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - .10 ASTM D 2657-(2015), Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .11 ASTM D 2992-18, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
 - .12 ASTM D 2996-2017, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - .13 ASTM F 714-13, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - .14 ASTM C 618-19, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .3 American Water Works Association (AWWA)/Manual of Practice
 - .1 AWWA M9-2008, Concrete Pressure Pipe.
 - .2 AWWA M11-2004, Steel Pipe - A Guide for Design and Installation.
 - .3 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.1-94, Pipe, Asbestos Cement, Pressure.
 - .4 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
- .5 CSA International
 - .1 CAN/CSA-A257 Series-09, Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - .2 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-B137 Series-13, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1-13, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3-13, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

- .4 CSA G30.18-09(R2014), Carbon and Steel Bars for Concrete Reinforcement.
- .6 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520-2016, Standard for Fire Hydrants.
 - .2 CAN/ULC-S543-09(R2016), Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .2 Shop Drawings:
 - .1 Submit complete drawings and construction schedule for water mains.
- .3 Testing, Disinfection, Sampling and Commissioning Plan:
 - .1 The plan shall detail the proposed disinfection procedures, sequencing, and duration of work required for the new watermain. The plan shall be completed by a 3rd party commissioning agent as retained by Contractor and shall follow the requirements of:
 - .1 OPSS.MUNI 441
 - .2 MECP - 2020 Watermain disinfection procedure
 - .3 AWWA Standards (C651-14 and C655-18)
 - .4 City of Kingston Municipal Standards and Procedures.
 - .5 NFPA 13 - Sprinklers (for minimum hydrostatic test pressure)
 - .2 The services of a specialized third-party shall be used to perform watermain commissioning in accordance with approved plan. The commissioning procedure shall be witnessed by the commissioning agent.
 - .3 The commissioning agent's endorsement of final tie-in and all test results are required to be submitted to DCC and DND for final approval prior to tie-in.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .2 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance 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 water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Owner.
- .3 Notify the DCC Representative minimum of 24 hours in advance of interruption in service.
- .4 Notify fire department of planned or accidental interruption of water supply to hydrants.
- .5 Provide and post "Out of Service" sign on hydrant not in use.
- .6 Advise local police department of anticipated interference with movement of traffic.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end, cast iron outside diameter.
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
 - .2 Composite epoxy impregnated fibreglass PVC pipe to ASTM D 2996, class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ANSI/ASTM D2992. Material to ASTM D2310, classification RTRP-11HZ-5001-PVC-13223.
- .2 Polyethylene pressure pipe:
 - .1 NPS 1/2 to NPS 6: to CAN/CSA-B137.1 type PE 3406, series 160 ASTM F 714, type PE 3408, series DR 11.
 - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE 1404, series 250.
 - .3 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D 2657.
 - .4 Polyethylene fittings: to CAN/CSA-B137.1, for pipe sizes NPS 4 and less.

2.2 VALVES AND VALVE BOXES

- .1 Valves to open in the same direction as municipal standards.
- .2 Gate valves: to OPSD Standards.

- .3 Butterfly valves: to OPSD Standards.
- .4 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.
 - .1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.
 - .2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.
 - .3 Valve complete with surge check unit.
 - .4 Ends to be flanged to ANSI/AWWA C110/A21.10.
- .5 Cast iron valve boxes: to OPSD Standards.

2.3 VALVE CHAMBERS

- .1 Valve chamber frames and covers: gray iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU"
- .2 Jointing materials:
 - .1 Manufacturer's rubber ring gaskets.
 - .2 Mastic joint filler.
 - .3 Cement mortar.
 - .4 Combination of above types.
- .3 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CSA G30.18, hot-dipped galvanized after fabrication to ASTM A123/A123M. Rungs to be safety pattern.

2.4 SERVICE CONNECTIONS

- .1 Polyvinyl chloride pressure pipe: to CAN/CSA-B137.3, type 1120 series 160, 1.1 MPa.
- .2 Polyethylene pressure pipe:
 - .1 To CAN/CSA-B137.1, type PE, series 160, ASTM F714, Type PE, series DR 11.
 - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE, series 250.
- .3 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .4 Polyethylene pipe joints: thermal butt fusion welded, plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint.
- .5 Joints for ductile iron pipe: push-on joints to ANSI/AWWA C111/A21.11. Rubber gaskets to ANSI/AWWA C111/A21.11. Verify requirement to maintain electrical conductivity between pipes.
- .6 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.
- .7 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.

- .8 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.
- .9 50 mm diameter stainless steel liners for plastic pipe where pipe is used with compression fitting.

2.5 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

2.6 BACKFILL MATERIAL

- .1 As indicated. In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.7 PIPE DISINFECTION

- .1 Sodium hypochlorite, calcium hypochlorite, liquid chlorine or sodium chlorite to ANSI/AWWA B300, ANSI/AWWA B301 and ANSI/AWWA B303 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651 and in accordance with MECP – 2020 Watermain Disinfection Procedure.

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 distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform the DCC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects.
 - .2 Remove defective materials from site.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 1.8 meter minimum from finished grade.
- .3 Trench alignment and depth require notification and inspection prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm below bottom of pipe to depth as indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95% minimum of corrected maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.5 PIPE INSTALLATION

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Bevel or taper ends of PVC pipe to match fittings.
- .3 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .5 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .9 Align pipes before jointing.
- .10 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

- .11 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .12 Complete each joint before laying next length of pipe.
- .13 Minimize deflection after joint has been made.
- .14 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .15 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes.
- .16 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .17 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .18 Do not lay pipe on frozen bedding.
- .19 Do hydrostatic and leakage test and have results provided to the DCC Representative before surrounding and covering joints and fittings with granular material.
- .20 Backfill remainder of trench.

3.6 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.7 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 300 mm inside right-of-way and roadway allowance.
- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O"

- ring seal cemented in place.
- .5 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
 - .6 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
 - .7 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
 - .8 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.
 - .9 Leave corporation stop valves fully open.
 - .10 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
 - .11 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
 - .12 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
 - .13 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.8 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints reviewed by the DCC Representative.

3.9 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify the DCC Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of the DCC Representative inspector.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after

- placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 m in length.
 - .6 Upon completion of pipe laying and after the DCC Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
 - .7 Leave hydrants, valves, joints and fittings exposed.
 - .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
 - .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
 - .10 Open valves.
 - .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
 - .12 Thoroughly examine exposed parts and correct for leakage as necessary.
 - .13 Apply hydrostatic test pressure of 1034 kPa minimum based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 2 hours.
 - .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
 - .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
 - .16 Repeat hydrostatic test until defects have been corrected.
 - .17 Apply leakage test pressure after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
 - .18 Define leakage as amount of water supplied from water metre in order to maintain test pressure for 2 hours.
 - .19 Do not exceed allowable leakage, including lateral connections.
 - .20 Locate and repair defects if leakage is greater than amount specified.
 - .21 Repeat test until leakage is within specified allowance for full length of water main.

3.10 PIPE SURROUND

- .1 Upon completion of pipe laying surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

- .1 Do not dump material within 1 m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% of corrected maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% of corrected maximum dry density.

3.11 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density.
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.12 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by the DCC Representative inspector.
 - .1 Notify the DCC Representative at least 5 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

<u>Pipe Size NPS</u>	<u>Flow (L/s) Minimum</u>
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed, introduce strong solution of chlorine as approved by DCC Representative into water main and ensure that it is distributed throughout entire system.
- .7 Disinfect water mains. Specialist contractor to perform disinfection. Disinfect water mains to the requirements of local authority.
- .8 Chlorine application to be close to point of filling water main and to occur at same time.

- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .10 Flush line to remove chlorine solution after 24 hours.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Specialist contractor to submit certified copy of test results.
- .13 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .14 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

3.13 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition.

3.14 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 82/A 82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - .2 ASTM A 185/A 185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - .3 ASTM C 139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
 - .4 ASTM C 478/C 478M, Standard Specification for Precast Reinforced Concrete Manhole Sections
 - .5 ASTM D 1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
- .2 CSA Group (CSA)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005)
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
 - .3 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS)

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 printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS SDS - Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings for precast manholes.
- .4 Quality Assurance Submittals: Submit in accordance with Section 01 45 00 - Quality Control
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 QUALITY ASSURANCE

- .1 Preinstallation Meetings: convene preinstallation meeting one week before beginning work of this Section and on-site installation, with contractor's representative and DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store, and handle materials in accordance with manufacturer's instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PVC DUCTS

- .1 PVC ducts, type DB2, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, red with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW ".

2.4 PULLING ROPE

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install underground duct banks including formwork.
- .2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.
- .3 Open trench completely between precast concrete transformer base and sectionalizing switchgear base before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .5 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts as shown on duct bank details on drawings.
 - .1 Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .2 Encase duct bank with 75 mm thick concrete cover.
- .7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .8 Use bell ends at duct terminations in transformer bases and sectionalizing switchgear.
- .9 Use conduit to duct adapters when connecting to conduits.
- .10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .11 Cut, ream and taper end of ducts on site in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .12 Allow concrete to attain 50% of its specified strength before backfilling.
- .13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete.
 - .1 Tie ducts to spacers with twine or other non-metallic material.
 - .2 Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Duct Cleaning:

- .1 Pull 300 mm long x diameter 6 mm less than internal diameter of duct wooden mandrel through each duct, immediately after placing of concrete.
- .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.
- .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .16 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings.
 - .1 Wire rods to 15M dowels at transformer pad and switchgear pad and support from duct spacers.
 - .2 Protect existing cables and equipment when breaking into existing switchgear base.
 - .3 Place concrete down sides of duct bank filling space under and around ducts.
 - .4 Rod concrete with flat bar between vertical rows filling voids.
- .17 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 WARNING TAPE

- .1 Provide continuous warning tape above entire length of duct bank. Tape to be installed half-way between the top of the duct bank and finished grade. Warning tape shall cover the entire width of the duct bank using multiple warning tapes as required.

3.3 SITE QUALITY CONTROL

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by DCC Representative before placing.
 - .2 Placement of concrete and duct cleanout to be done when DCC Representative present.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning & Waste Management.

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 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance Submittals: Submit in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: Signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: For installation and special handling criteria, installation sequence and cleaning procedures.

1.3 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:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: Remove for reuse and return of packaging materials in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC Duct: Type DB2, with moulded fittings, for direct burial, Trade size 6.
 - .1 Nominal Length: 3 m plus or minus 12 mm.
- .2 Rigid PVC split ducts.
- .3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .4 Rigid PVC 90 degrees, 45 degrees bends and 5 degrees angle couplings as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.

2.3 PULLING ROPE

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, red with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW ".

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 duct in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of ducts before laying.
- .3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Place continuous strip of warning tape 300 mm above duct before backfilling trenches. Tape shall cover full width of the duct bank.
- .9 Notify the DCC Representative for site review upon completion of direct buried ducts and obtain acceptance before backfilling.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning & Waste Management.
- .2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION