

REPLACEMENT OF THE VENTILATION SYSTEM – BUILDING 18

BFA 2022-146

Specification Mechanical / Electrical
Emission for construction

For :



Correctional service Canada



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SPECIFICATIONS

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END OF SECTION

.1 MECHANICAL

DRAWING N°	DESCRIPTION	REVISION N°
H-00	Cover page	
H-01	Legend	
H-02	HVAC – Ground floor – General – Demolition	
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H-04	HVAC – Ground floor – Part B – Demolition	
H-05	HVAC – Ground floor – General – New	
H-06	HVAC – Ground floor – Part A – New	
H-07	HVAC – Ground floor – Part B - New	
H-08	HVAC – Floor – General – Demolition	
H-09	HVAC – Floor – Part A – Demolition	
H-10	HVAC – Floor – Part B – Demolition	
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H-12	HVAC – Floor – Part A – New	
H-13	HVAC – Floor – Part B – New	
H-14	HVAC – Roof – Demolition	
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H-16	Plumbing – Floor – General and extract	
H-17	HVAC – Details	
H-18	HVAC – Details	
H-19	Plumbing – Details	
H-20	Control - Details	

.2 ELECTRICAL

DRAWING N°	DESCRIPTION	REVISION N°
E-00	Cover page	
E-01	Legend	
E-01A	Electricity – Ground floor – Demolition	
E-01B	Electricity – Ground floor – New	
E-02A	Electricity – Floor – Demolition	
E-02B	Electricity – Floor – New	
E-03A	Electricity – Roof – Demolition	
E-03B	Electricity – Roof - New	

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the replacement of air conditioning units and the modification of the ventilation ducts of building 18, located at 400, Fordyce Avenue, Cowansville.

1.2 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from the Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to the Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

1.3 FUTURE WORK

- .1 Insure that Work avoids encroachment into areas required for future work.

1.4 WORK SEQUENCE

- .1 Construct Work in stages to accommodate the Departmental Representative's use of premises during construction.
- .2 Co-ordinate Progress Schedule according to the site occupation.
- .3 Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Maintain fire access/control.

1.5 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, for storage, and for access, to allow:
 - .1 Partial occupancy by the Departmental Representative.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.

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

1.6 OCCUPANCY BY THE DEPARTMENTAL REPRESENTATIVE

- .1 The Departmental Representative will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with the Departmental Representative in scheduling operations to minimize conflict and to facilitate the Departmental Representative usage.

1.7 PARTIAL OCCUPANCY BY THE DEPARTMENTAL REPRESENTATIVE

- .1 Schedule and substantially complete designated portions of Work for the Departmental Representative's occupancy prior to Substantial Performance of entire Work.
- .2 The Departmental Representative will occupy designated areas for the purpose of storage of furnishings and equipment.
- .3 Execute Certificate of Substantial Performance for each designated portion of Work prior to the occupancy by the Departmental Representative. Contractor shall allow:
 - .1 Access for the Departmental Representative personnel.
 - .2 Use of parking facilities.
 - .3 Operation of HVAC and electrical systems not related to the construction.
- .4 When present on the premises and for those areas of occupancy, the Departmental Representative will provide:
 - .1 Operation of HVAC and electrical systems.
 - .2 Maintenance.
 - .3 Security.
- .5 Execute Partial Interim Certificate of Completion for each designated portion of Work prior to the Departmental Representative occupancy. Contractor shall allow:
 - .1 Access for the Departmental Representative personnel.

1.8 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Use only the path determined by the Departmental Representative for moving workers and material.

1.9 EXISTING UTILITY SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours 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 governing authorities with minimum disturbance to operations.
- .3 Provide alternative routes for personnel traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental 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.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .8 Record locations of maintained, re-routed and abandoned service lines.

1.10 DURATION OF WORK

- .1 The expected duration of the work will be 6 weeks, following the delivery of the new air conditioning units.
- .2 The contractor will be able to start its organization on site 3 weeks before the delivery of the units in order to allow the site to be prepared for the work.
- .3 A total of 9 weeks are planned for the duration of the work.

1.11 REQUIRED DOCUMENTS

- .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.

END OF SECTION

1 General

1.1 ACCESS AND EGRESS

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

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with department 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.
- .4 Use only stairs and elevators, existing in building for moving workers and material.
 - .1 Protect walls of passenger elevators, to approval of Department Representative prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to department representative and normal use of premises. Arrange with Department Representative to facilitate execution of work.

1.4 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.

1.5 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances:
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
 - .3 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
 - .4 Contractor's personnel will require satisfactory RCMP initiated security screening in order to complete Work in premises and on site.
- .3 Security escort:
 - .1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.
 - .2 Submit an escort request to Department Representative at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be paid for by Department Representative. Cost incurred by late request will be Contractor's responsibility.

- .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.
- .4 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and of 4 hours for late cancellations.

1.6 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted.

END OF SECTION

1 General

1.1 PRECONSTRUCTION MEETING

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

1.2 PROGRESS MEETINGS

- .1 During course of Work and every week prior to project completion, schedule progress meetings every 2 weeks.
- .2 Notify parties minimum 7 days prior to meetings.
- .3 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

END OF SECTION

1 General

1.1 DEFINITIONS

- .1 Activity: Distinct, scheduled portion of work performed during course of a project.
- .2 Activity Duration: time in calendar units between start and finish of a scheduled activity. See also Duration.
- .3 Assumption: factor in planning process that is considered true, real, or certain without proof or demonstration.
- .4 Bar Chart (Gantt Chart): graphic display of schedule-related information.
 - .1 In typical bar chart, schedule activities or work breakdown structure components are listed down left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
- .5 Baseline: approved version of a work product that can be changed only through formal change control procedures and is used as a basis for comparison.
- .6 Budget: approved estimate for a project or work breakdown structure component or schedule activity.
- .7 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
- .8 Change Control: process whereby modifications to documents, deliverables, or baselines associated with a project are identified, documented, approved, or rejected.
- .9 Completion Milestones: they are firstly 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.
- .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 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.
- .28 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.
- .29 Lag: amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.
- .30 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.
- .31 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.
- .32 Lead: amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
- .33 Logic Diagram: see Project network diagram.
- .34 Logical Relationship: dependency between two activities or between an activity and a milestone.
- .35 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure components, and key schedule milestones.
- .36 Milestone: significant point or event in a project, program, or portfolio.
- .37 Monitor: collect project performance data with respect to a plan, procedure performance measures, and report and disseminate performance.
- .38 Network: see Project Schedule Network Diagram.
- .39 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .40 Project Control System: fully computerized system utilizing commercially available software packages.
- .41 Project Management: application of knowledge, skills, tools, and techniques, to project activities to meet project requirements.
- .42 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.

- .43 Project Management Planning: development and maintenance of Project Management Plan.
- .44 Project Management Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
- .45 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
- .46 Project Schedule Network Diagram: graphical representation of logical relationships among project schedule activities.
 - .1 Always drawn from left to right to reflect Project chronology.
- .47 Project Scope: work performed to deliver a product, service, or result with specified features and functions.
- .48 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .49 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on one or more project objectives.
- .50 Schedule: see Project Schedule.
- .51 Schedule Data: collection of information for describing and controlling schedule.
- .52 Scope: see Project Scope.
- .53 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.
- .54 Work Breakdown Structure (WBS): hierarchical decomposition of total scope of work to be carried out by project team to accomplish project objectives and create the required deliverables.

1.2 REFERENCE STANDARDS

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

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Project Meeting:
 - .1 Meet with Department Representative within 15 after working days of Award of Contract date, to establish Work requirements and approach to project construction operations.
 - .2 Participate in regular project progress meetings with Department Representative specifically intended to discuss update of detailed schedule and contract changes.
- .2 Scheduling:
 - .1 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
 - .2 Ensure project schedule efficiencies through monitoring of project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitor sufficiently often so that causes of delays can immediately be identified and mitigated.
- .3 Project monitoring and reporting:
 - .1 Keep team aware of changes to schedule, and potential consequences as project progresses.
 - .2 Use narrative reports to provide advice on seriousness of challenges and measures to overcome them.

- .3 Begin narrative reporting with statement on general status of project followed by summarization of delays, potential problems, corrective measures and project status criticality.
- .4 Critical Path Method (CPM) Requirements:
 - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified contract duration.
 - .2 Revise Master Schedule and Detail Schedule deemed impractical by Department 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 Department 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 Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
 - .9 Delays to non-critical activities with float may not be basis for time extension.
 - .10 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.
 - .11 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.
 - .12 Arrange participation on and off site of subcontractors and suppliers, as required by Department Representative, for purpose of network planning, scheduling, updating and progress monitoring.
 - .1 Approvals by Department Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
 - .13 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Department Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to Department Representative for approval.
 - .1 Failure to comply with each required submission, may result in progress payment being withheld in accordance with Federal Government's GC 5 Terms of Payment.
- .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 impact analysis of schedule for changes that result in extension of contract duration.
 - .1 Include draft schedule update and report as outlined in article "PROGRESS MONITORING AND REPORTING".
- .8 Submit Project planning, monitoring and control system data as required by in following form.
 - .1 Construction Detail Schedule Bar Chart.
 - .2 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.

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 MASTER SCHEDULE

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

1.7 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 6 months beginning from Award of Contract date with duration of each activity approximately 5 days.
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
- .3 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.
- .4 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.
- .5 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.
- .6 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Department representative for review effects created by insertion of new Change Order.

1.8 REVIEW OF CONSTRUCTION DETAIL SCHEDULE

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

1.9 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 Department 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 with more experience/qualifications on site for effected activities or work package.
 - .2 Increase in materials.
 - .3 Overtime work.
- .4 Submit to Department Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. As part of supporting evidence, include:

- .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
- .2 Prepared schedule indicating how change will be incorporated into overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
- .3 Other supporting evidence requested by Department Representative.
- .4 Do not assume approval of Contract extension prior to receipt of written approval from Department 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 Department 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.

1.10 PROGRESS AND REPORTING

- .1 On an ongoing basis, Detail Schedule on job site to show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Department 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 every 2 weeks 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 Department Representative copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate potential delay. Include in report:
 - .1 Description of progress made.
 - .2 Pending items and status of: shop drawings.
 - .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.

END OF SECTION

1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Submit to DEPARTMENT 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.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals before submission to DEPARTMENT Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify DEPARTMENT Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify site measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by DEPARTMENT Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DEPARTMENT Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to Contract drawings and specifications.
- .4 Allow 7 days for DEPARTMENT Representative's review of each submission.
- .5 Adjustments made on shop drawings by DEPARTMENT Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DEPARTMENT Representative before proceeding with Work.
- .6 Make changes in shop drawings as DEPARTMENT Representative may require, consistent with Contract Documents. When resubmitting, notify DEPARTMENT Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data, and sample.
 - .5 Other pertinent data.

- .8 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of site measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified site dimensions and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After DEPARTMENT Representative's review, distribute copies.
- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as DEPARTMENT Representative may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by DEPARTMENT Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by DEPARTMENT 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.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by DEPARTMENT 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 Contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by DEPARTMENT 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.
- .15 Submit electronic copies of Manufacturer's Site Reports for requirements requested in specification Sections and as requested by DEPARTMENT Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by DEPARTMENT Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.

- .20 If upon review by DEPARTMENT Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PSPC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at the project site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of Work of Subcontractors.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to DEPARTMENT Representative's.
- .3 Notify DEPARTMENT Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where color, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by DEPARTMENT Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DEPARTMENT Representative before proceeding with Work.
- .6 Make changes in samples which DEPARTMENT Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 CERTIFICATES AND TRANSCRIPTS

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

END OF SECTION

1. GENERAL INFORMATION

1.1. PURPOSE

- 1.1.1. To ensure that the work and institutional activities are carried out smoothly with no undue delays, and that institutional security is maintained at all times.

1.2. DEFINITIONS

- 1.2.1. « CSC » Correctional Service Canada.
- 1.2.2. « Warden » Warden of the institution.
- 1.2.3. « Departmental representative » Any employee who is mandated to intervene, carry out supervision, ensure coordination and/or supervision of the work.
- 1.2.4. « Work enclosure » Area where, as indicated on the project plans, the contractor is authorized to work. This can be isolated from the perimeter of the institution.
- 1.2.5. « Perimeter » Area of the establishment surrounded by fences or walls preventing the movement of inmates.
- 1.2.6. « Prohibited items » :
- a) Intoxicants, including alcohol, drugs and narcotics;
 - b) A weapon or a component thereof, ammunition, or anything that is designed to kill, injure or disable a person or that can be assembled or modified for such purposes, possessed without prior authorization;
 - c) An explosive or a bomb, or a component thereof;
 - d) An amount of money exceeding the regulatory limit;
- NOTE:** Consult the *Corrections and Conditional Release Regulations* (SOR/92-620): \$50 limit in a minimum-security institution, \$25 limit in a medium-security institution, maximum-security institution, or multi-level security institution.
- e) Any other item possessed without prior authorization that could jeopardize the security of the penitentiary or the safety of persons;
 - f) Electronic or telecommunication devices;
 - g) Tobacco products and associated products (including, but not limited to, cigarettes, electronic cigarettes, cigars, tobacco, chewing tobacco, cigarette-making machines, matches and lighters) are considered unauthorized items.
- 1.2.7. « Commercial vehicle » Vehicle intended for the transportation of material, equipment or tools necessary for the work.

1.3. PRELIMINARY MEASURES

- 1.3.1. Prior to starting the work, the Contractor must communicate with the Departmental representative to:
- a) Discuss the nature and the scope of the work associated with the project;
 - b) Establish mutually-acceptable security measures, in accordance with this directive and the specific needs of the institution.

- 1.3.2. The Contractor must:
- a) Be sure to inform their employees of the security requirements;
 - b) Work with institutional staff to ensure that their employees comply with the security requirements.

1.4. CONTRACTOR'S EMPLOYEES

- 1.4.1. According to the Warden's preference, the Contractor must be aware that no employee will be admitted access to the institution without valid security clearance and have a recent photo identification card, such as a provincial driver's licence.
- 1.4.2. The Contractor must submit to the Departmental representative a list of the names and birth dates of all his employees scheduled to work in the institution or all other CSC site, as well as their completed security clearance forms (*Federal Institution Access Request* form). Allow two (2) weeks for the security clearance forms to be processed.
- 1.4.3. The Warden may require that headshots be taken of the Contractor's Employees so that their pictures can be posted in appropriate areas throughout the institution or entered into a database for identification purposes. The Warden may also require that the Contractor's Employees prominently display photo identification on their clothing when they are within the institutional perimeter.
- 1.4.4. An individual will be refused entry to institutional premises if there is reason to believe that they pose a security risk.
- 1.4.5. Individuals will be immediately removed from institutional premises if:
- c) They appear to be under the influence of alcohol, drugs or narcotics;
 - d) They behave in an abnormal or disorderly manner;
 - e) They are in possession of prohibited items.
- 1.4.6. Before accessing the institution, any individual may be required to fill out a form or to answer questions concerning their immediate health state. When requested by the Warden, the individual's body temperature may be checked. Following these verifications, CSC might choose to refuse access to any individual.

1.5. VEHICLES

- 1.5.1. The personal vehicles of the Contractor's Employees are not allowed within the perimeter of medium- or maximum-security institutions without the express permission of the Warden.
- 1.5.2. All individuals who leave a vehicle unattended on CSC premises must close the windows and lock the doors and trunk. The owner of the vehicle or the employee from the company that owns the vehicle must ensure that the keys are kept safely in their personal possession.
- NOTE:** The institution may require that all vehicles and motorized equipment be equipped with a device that allows for locking the fuel cap.
- 1.5.3. The Warden can limit the number and type of vehicles permitted within the perimeter at any time.
- 1.5.4. Those delivering materials needed for the work may be required to have security clearance.
- 1.5.5. Should the Warden allow trailers to be left within the institution's perimeter, the doors and windows must remain closed and locked when left unattended. Windows must be equipped with expanded metal grates.

1.6. PARKING

- 1.6.1. The Departmental representative designates authorized parking areas for vehicles. If the Contractor's Employees Park elsewhere, their vehicle may be towed.

1.7. SHIPMENTS

- 1.7.1. All shipments of material, equipment or tools for the work must be addressed to the Contractor to clearly distinguish them from shipments for the institution. The Contractor must ensure that his employees are on site to receive deliveries, as CSC staff will **not** accept deliveries of materials, equipment or tools intended for the Contractor.

1.8. COMMUNICATION DEVICES

- 1.8.1. Cellular or digital cordless phones (including, but not limited to, text messaging devices, pagers, BlackBerry, and telephones used as two-way radios), laptop computers and tablets are prohibited in the institution without the express authorization of the Warden. Even when permitted, they are not to be used by inmates.
- 1.8.2. The Warden may approve but limit the use of two-way radios.

NOTE: In some institutions, cellular or digital phones and two-way radios are permitted; however, conditions may apply. For example, their use may not be permitted in areas accessible to inmates.

1.9. TOOLS AND EQUIPMENT

- 1.9.1. The Contractor must keep a comprehensive list of the tools and equipment used during the work. This list must be kept up-to-date throughout the work and be submitted for inspection when necessary.

NOTE: A list of unauthorized or restricted tools and equipment may be provided to the Contractor if necessary.

- 1.9.2. The Contractor's Employees must never leave tools unattended, particularly mechanical tools, files, saw blades, hacksaws, wire, rope, ladders and any item used for lifting (jacks, cylinders, etc.).
- 1.9.3. The Contractor's Employees must store tools and equipment in a secure, authorized location.
- 1.9.4. The Contractor's Employees must lock all toolboxes after use and keep the keys with them at all times. They must also lock scaffolding that is not being used; once erected, scaffolding must be secured to the satisfaction of the Departmental representative.
- 1.9.5. The Contractor's Employees must notify the Departmental representative immediately if any tools or equipment have been lost or are unaccounted for.
- 1.9.6. The Warden will ensure that security staff verifies the Contractor's tools and equipment based on the list provided by the Contractor, at the following times:
- a) at the beginning and end of each project;
 - b) each week, if the work lasts more than one (1) week.

NOTE: Some institutions require that tools and equipment be removed from the work site on a daily basis (e.g., in a busy area).

1.9.7. Some tools and equipment - such as cartridges and metal saw blades - are closely controlled. At the beginning of the day, the Contractor will be given a sufficient number of these items for one (1) day's work. Used blades/cartridges must be returned to the security personnel at the end of each day.

1.9.8. The use of fastening tools or other tools with cartridges is strictly prohibited.

NOTE: Controlled items are managed differently from one institution to another and must be verified with the specific institution.

1.9.9. If propane or natural gas is used as a heat source for the work, the institution requires that a member of its personnel supervise the work site outside of regular working hours.

NOTE: This is a concern if the work site is located near inmates' living units. A fire could put human lives in danger. Check the institution's policy.

1.10. KEYS

1.10.1. During the work, the Contractor must use regular cylinders in regular locks.

1.10.2. Once the security locks are installed, the Departmental representative who escorts the Contractor's Employees must obtain the keys in order to open doors according to the Contractor's needs. The Contractor must inform his employees that only the Departmental representatives escorting them are authorized to use the keys.

1.11. PRESCRIPTION MEDICATION

1.11.1. If the Contractor employs individuals who must take prescription medication during the work day, these employees must obtain authorization from the Warden to bring one (1) day's dosage into the institution.

1.12. RESTRICTIONS ON TOBACCO USE

1.12.1. Neither Contractors nor the Contractor's Employees are permitted to smoke inside correctional institutions, nor outside while within the perimeter of a correctional institution. They must not have unauthorized tobacco products in their possession within the institutional perimeter.

1.12.2. All individuals who violate this policy will be asked to stop smoking or to throw out all unauthorized tobacco products immediately. Individuals who continue to violate this policy will be asked to leave the institution.

1.12.3. Smoking will only be permitted outside the correctional institution's perimeter, in a location designated by the Departmental representative.

1.13. PROHIBITED ITEMS

1.13.1. Firearms, ammunition, explosives, alcohol, drugs and narcotics are prohibited on institutional premises.

1.13.2. The Warden must be notified immediately if anyone is found in possession of prohibited items on the work site.

1.13.3. The Contractor must be vigilant in monitoring their employees as well as the employees of their Subcontractors. Individuals found in possession of prohibited items may have their security clearance revoked. If the violation is serious, the company in question may be expelled from the institution for the duration of the work.

1.13.4. If firearms or ammunition are found in the vehicle of a Contractor, Subcontractor, supplier, or their personnel, the security clearance of the vehicle's driver will be revoked immediately.

1.14. SEARCHES

- 1.14.1. All individuals and vehicles arriving on the institution's premises may be searched.
- 1.14.2. If the Warden has reason to believe that one of the Contractor's Employees is in possession of a prohibited item, the Warden may order a search of that individual.
- 1.14.3. The personal belongings of all the Contractor's Employees arriving at the institution may be checked to search for the residue of contraband drugs.

1.15. CONTACT WITH INMATES

- 1.15.1. It is prohibited to enter into contact with inmates, speak to them, give them anything or accept anything from them without specific authorization. Anyone who violates this order will be expelled from the site and have their security clearance revoked.
- 1.15.2. It is prohibited to photograph inmates or CSC employees. It is also prohibited to photograph sectors of the institution when such photography is not required for the execution of the present contract.

2. EXECUTION

2.1. ACCESS TO THE INSTITUTION

- 2.1.1. Neither the Contractor's Employees nor commercial vehicles may be admitted to the institution's premises outside normal working hours without the express authorization of the Departmental representative.
- 2.1.2. The work week at the facility is Monday to Friday, generally 7:30 a.m. to 4 p.m. Hours of work vary from institution to institution. They should be checked with the institution concerned.

2.2. DAILY WORK PROGRAM

- 2.2.1. The contractor must send a daily work program to the departmental representative in the form of an email one day in advance and before noon, so that he can coordinate the work with the operations and security of the institution as well as with other work in progress and schedule the security escorts required for surveillance. The contractor must notify the departmental representative as soon as possible if there are any changes to the day's schedule, e.g.: interruption or need for extension of work, etc.

2.3. VEHICLE TRAFFIC

- 2.3.1. Vehicles may enter and leave the facility escorted through the vehicle access barrier, at the times specified by the Departmental representative for each site. Note that service barriers will be inaccessible during the lunch hour.

NOTE: Hours vary from one institution to the next. They should be verified with the institution concerned.

- 2.3.2. The Contractor must provide the Departmental representative forty-eight (48) hours notice of the arrival of heavy equipment.
- 2.3.3. Vehicles carrying detritus or other material deemed impossible to search must constantly be monitored by CSC employees or security personnel who report to the Warden or must wait for an official head-count of the inmates to be conducted.

- 2.3.4. Before a commercial vehicle may be admitted onto the institution's perimeter, the Contractor or its representative must certify that the vehicle's content is essential to the execution of the work.
- 2.3.5. Entry will be refused to all vehicles carrying materials that the Warden believes pose a risk to institutional security.

2.4. CIRCULATION OF THE CONTRACTOR'S EMPLOYEES ON INSTITUTIONAL PREMISES

- 2.4.1. Subject to proper institutional security, the Warden will give the Contractor and the Contractor's Employees as much freedom of movement and autonomy as possible.
- 2.4.2. The previous paragraph notwithstanding, the Warden may:
 - a) Prohibit access to sections of the institution;
 - b) Require that the Contractor's Employees be accompanied by CSC security personnel in designated sections;
 - c) Require that the Contractor's Employees remain on-site during coffee/health and lunch breaks, depending on the institution and the situation. The Contractor's Employees are not authorized to eat in the break room of CSC employees, but they may use another area designated by the Departmental representative.

2.5. UNINSTALLED EQUIPMENTS AND ACCESSORIES

- 2.5.1. Return all uninstalled devices, devices, equipment, accessories or hardware to the Departmental Representative to ensure that they are disposed of or kept in a safe place for later reuse. If authorized by the departmental representative, dispose of it responsibly.

2.6. MONITORING AND INSPECTION

- 2.6.1. CSC security personnel will monitor and inspect the Contractor's Employees activities as well as related movement and vehicle traffic to ensure that established security standards are being followed.
- 2.6.2. At the start and throughout the duration of the work, CSC staff will convey to the Contractor's Employees the necessity of monitoring and inspections.

2.7. WORK STOPPAGE

- 2.7.1. At any time, the Warden may ask the Contractor, the Contractor's Employees, or Subcontractors not to enter the work site or to leave immediately if a security incident is in progress in the institution. The Contractor's Employees must note the name of the CSC employee issuing the request as well as the time and comply with the order as soon as possible.
- 2.7.2. Once notified, the Contractor must inform the Departmental representative of work stoppage without delay.

2.8. WORK COMPLETION

- 2.8.1. Unless otherwise indicated in the contract, once the project is completed or the facilities handed back to the CSC, the Contractor must remove all materials, tools and equipment from the institution, as well as perform a final clean-up of the site.

END OF SECTION

Partie 1 **General**

GENERAL NOTE: in this section the term “site” includes all the facilities located at the site where the work is taking place (construction site, buildings, access, infrastructure, parkings, bays, etc.).

1.1 **REFERENCES**

- .1 Province of Québec
 - .1 Loi sur la santé et la sécurité du travail L.R.Q., c. S-2.1 (Act respecting occupational health and safety).
 - .2 Code de sécurité pour les travaux de construction L.R.Q., c. S-2.1, r.4 (Safety code for the construction industry).

1.2 **ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental representative, and the CNESST the site-specific prevention program, as outlined in the article “GENERAL REQUIREMENTS”, at least 10 days prior to the start of work.
- .3 Departmental representative will review Contractor’s site-specific prevention program and provide comments to Contractor within 10 days after receipt of the document. Revise plan as appropriate and resubmit to Departmental representative within 5 days after receipt of comments from Departmental representative. Departmental representative reserves the right not to authorize the start of work on the construction site as long as the content of the prevention program is not satisfactory. The Contractor shall then update his prevention program and resubmit it to the Departmental representative if the scope of work changes or if the working methods of the Contractor differ from his initial plans or for any other applicable new condition.
- .4 Departmental representative’s review of Contractor’s site-specific prevention program should not be construed as approval of the program and does not reduce the Contractor’s overall responsibility for construction Health and Safety during the work.
- .5 Submit copies of Contractor’s authorized representative’s construction site health and safety inspection reports to Departmental representative, determine frequency, but at least once a week.
- .6 Submit to Departmental representative within 24 hours a copy of any inspection report, correction notice or recommendation issued by Federal, Provincial and Territorial health and safety inspectors.

- .7 Submit to Departmental representative within 24 hours an investigation report for any accident involving injury and any incident exposing a potential hazard.
- The investigation report shall contain at least the following:
1. date, time and place of accident;
 2. name of sub-contractor involved in the accident;
 3. number of persons involved and condition of wounded;
 4. witness identification;
 5. detailed description of tasks performed at the time of the accident;
 6. equipment being used to accomplish the tasks performed at the time of the accident;
 7. corrective measures taken immediately after the accident;
 8. causes of the accident;
 9. preventive measures that have been put in place to prevent a similar accident.
- .8 Submit to Departmental representative WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 – Submittals. Contractor must also keep one copy of these documents on the construction site.
- .9 Medical Surveillance: where prescribed by legislation, regulation or prevention program, submit certification of medical surveillance for construction site personnel prior to commencement of Work, and submit additional certifications for any new construction site personnel to Departmental representative.
- .10 Submit to Departmental representative an on-site Emergency Response Plan at the same time as the prevention program. The Emergency Response plan must contain the elements listed in the article "GENERAL REQUIREMENTS" of this section.
- .11 Submit to Departmental representative copies of all training certificates required for the application of the prevention program, in particular (if applicable) for the following:
- .1 first aid in the workplace and cardiopulmonary resuscitation;
 - .2 work likely to release asbestos dust (mandatory for all work where asbestos is present);
 - .3 work in confined spaces (mandatory for all work in confined spaces);
 - .4 lockout-tagout procedures (mandatory for all work requiring lockout);
 - .5 safely operating forklift trucks (mandatory for all forklift usage);
 - .6 safely operating elevating work platforms (mandatory for the use of all elevating platforms);
 - .7 any other requirement of Regulations or the safety program.
- In addition, the certifications of the *Cours de santé et sécurité générale pour les chantiers*

de construction (General Health and Safety Training for Construction Sites) shall be available on demand on the construction site.

- .8 Engineer's plans and certificates of compliance: Contractor must submit to the Departmental representative and to the *Commission des normes, de l'équité, de la santé et de la sécurité du travail* (CNESST) a copy signed and sealed by engineer of all plans and certificates of compliance required pursuant to the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the construction industry) or by any other legislation or regulation or by any other clause in the specifications or in the contract. The Contractor must also submit a certificate of conformity signed by an engineer once the facility for which these plans were prepared has been completed and before a person uses the facility. A copy of these documents must be available on site at all times.

1.3 **FILING OF NOTICE OF CONSTRUCTION SITE OPENING**

- .1 Notice of construction site opening shall be submitted to the CNESST before work begins. A copy of such notice and acknowledgment of receipt from the CNESST shall be submitted to Departmental representative.

At the completion of all the work, a notice of construction site closing shall be submitted to the CNESST, with a copy to Departmental representative.
- .2 The Contractor shall assume the role of being the Principal Contractor in the limits of the construction site and elsewhere where he must execute work within the framework of this project. The Contractor shall recognize the responsibility of being the Principal Contractor of the project and identify himself as such in the notice of the construction site opening, he provides to the CNESST.
- .3 The Contractor shall accept to divide and identify the construction site adequately in order to define time and space at all times throughout the course of the project.

1.4 **HAZARD ASSESSMENT**

- .1 The contractor must perform construction site specific safety hazard assessment related to project.

1.5 **MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Departmental representative prior to commencement of Work.
- .2 Contractor's representative with decision power must attend any meetings at which construction site safety and health issues are to be discussed.

- .3 If it is anticipated that there will be 25 workers or more on the construction site at any given time, the Contractor shall set up a worksite committee and hold meetings as required by the *Code de sécurité pour les travaux de construction* (S-2.1, r. 4) (Safety code for the construction industry). A copy of the minutes of the meetings of the committee shall be provided to the Departmental representative no later than 5 days after the committee meeting.

1.6 REGULATORY REQUIREMENTS

- .1 Do the Work in accordance with Section 01 41 00 - Regulatory Requirements.
- .2 Comply with all legislation, regulations and standards applicable to the construction site and its related activities.
- .3 Comply with specified standards and regulations to ensure safe operations on a site containing hazardous or toxic materials.
- .4 Always use the most recent version of the standards specified in the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the construction industry), notwithstanding the date indicated in that *Code*.

1.7 COMPLIANCE REQUIREMENTS

- .1 Comply with the *Loi sur la santé et la sécurité du travail* (L.R.Q., c. S-2.1) (Act Respecting Occupational Health and Safety) and the *Code de sécurité pour les travaux de construction* (S-2.1, r. 4.) (Safety code for the construction industry) in addition to respecting all the requirements of this specification manual.

1.8 RESPONSIBILITIES

- .1 The Contractor must acknowledge and assume all the tasks and obligations which customarily devolve upon a principal Contractor under the terms of the *Loi sur la santé et la sécurité du travail* (L.R.Q., ch. S-2.1) (Act Respecting Occupational Health and Safety) and the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the construction industry).
- .2 The Contractor must be responsible for health and safety of persons on construction site, safety of property on construction site and for the protection of persons adjacent to construction site and the environment to the extent that they may be affected by conduct of the work.
- .3 No matter the size or location of the construction site, the Contractor must clearly define the limits of the construction site by physical means and respect all specific regulation requirements applicable in this regard. The means chosen to define the limits of the construction site must be submitted to the Departmental representative.

- .4 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific prevention Plan.

1.9 WORK PERFORMED BY EXTERNAL CONTRACTORS

- .1 On this construction site, it is anticipated that work will be performed by an external contractor that has not been hired by the Contractor:
- .2 The Contractor must take the necessary steps to protect the health and safety of external contractors that have no contractual link with the Contractor but have been mandated by the Departmental representative to perform certain work. In return, these external contractors are obligated to submit to the authority of the Contractor (Principal Contractor). A subordination agreement must be signed by the Contractor and by each external contractor to this effect and submitted to the Departmental representative prior to the start of the work of each contractor (see the wording in the article HEALTH AND SAFETY SUBORDINATION AGREEMENT)

1.10 GENERAL REQUIREMENTS

- .1 Before undertaking the work, prepare a site-specific prevention program based on the hazards identified according to the article “HAZARD ASSESSMENT” and the article “RISKS INHERENT TO THE WORKSITE” in this section. Apply this program in its totality from the start of the project until demobilization of all personnel from the construction site. The prevention program shall take into consideration the specific characteristics of the project and cover all the work to be executed on the construction site.

The safety program must include at least the following:

- .1 company safety and health policy;
- .2 description of the stages of the work;
- .3 total costs, schedule and projected workforce curves;
- .4 flow chart of safety and health responsibilities;
- .5 physical and material layout of the construction site;
- .6 risk assessment for each stage of the work, including preventive measures and the procedures for applying them;
- .7 identification of the preventive measures relative to the specific risks inherent to the worksite indicated in the article “RISKS INHERENT TO THE WORKSITE”;
- .8 identification of preventive measures for health and safety of employees and / or public works site as indicated in the article “SPECIFIC REQUIREMENTS FOR THE HEALTH AND SAFETY OF OCCUPANTS AND PUBLIC”;

- .9 training requirements;
- .10 procedures in case of accident/injury;
- .11 written commitment from all parties to comply with the safety program;
- .12 construction site inspection checklist based on the preventive measures;
- .13 emergency response plan which shall contain at least the following:
 - .1 construction site evacuation procedures;
 - .2 identification of resources (police, firefighters, ambulance services, etc.);
 - .3 identification of persons in charge of the construction site;
 - .4 identification of the first-aid attendants;
 - .5 communication organizational chart (including the person responsible for the site and the Departmental representative);
 - .6 training required for those responsible for applying the plan;
 - .7 any other information needed, in the light of the construction site's characteristics.

If available the Departmental representative will provide the evacuation procedures to the Contractor who shall then coordinate the construction site procedure with that of the site and submit it to the Departmental representative.

- .2 Departmental representative may respond in writing, where deficiencies or concerns are noted in the prevention program and may request resubmission with correction of deficiencies or concerns.
- .3 In addition to the prevention program, during the course of the work the Contractor shall elaborate and submit to the Departmental representative specific written procedures for any work having a high risk factor of accident (for example: demolition procedures, specific installation procedures, hoisting plan, procedures for entering a confined space, procedures for interrupting electric power, etc.) or at the request of the Departmental representative.
- .4 The Contractor shall plan and organize work so as to eliminate the danger at source or ensure collective protection, thereby minimizing the use of personal protective equipment.
- .5 Equipment, tools and protective gear which cannot be installed, fitted or used without compromising the health or safety of workers or the public shall be deemed inadequate for the work to be executed.
- .6 All mechanical equipment (for example, but not limited to: hoisting devices for persons or materials, excavators, concrete pumps, concrete saws) shall be inspected before delivery to the construction site. Before using any mechanical equipment, the Contractor shall obtain a certificate of compliance signed by a qualified mechanic dated less than a week prior to the arrival of each piece of equipment on the construction site; the certificate shall remain on the construction site and transmitted to the Departmental representative on demand.

- .7 Ensure all inspections (daily, periodic, annual, etc.) for the hoisting devices for persons or materials required by the current standards are carried out and be able to provide a copy of the inspection certificates to the Departmental representative on demand.
- .8 The Departmental representative can at all times, if he suspects a malfunction or the risk of an accident, order the immediate stop of any piece of equipment and require an inspection by a specialist of his choice.
- .9 The Departmental representative must be consulted for the location of storing gas cylinders and tanks on the construction site.

1.11 RISKS INHERENT TO THE WORKSITE

- .1 In addition to the risks related to the tasks to be carried out, personnel responsible for the execution of the work on the construction site will be exposed to the following risks, inherent to the area where the work will be executed.

At the worksite there is in particular the presence of the following:

- .1 materials containing asbestos;
- .2 materials containing lead;
- .3 moulds;
- .4 other dangerous materials (specify);
- .5 confined spaces;
- .6 overhead power lines;
- .7 underground services (electric, gas, vapour, water system, etc.);
- .8 laboratories;
- .9 trees and landscaping to preserve and protect;
- .10 potentially unstable ground;
- .11 barbed wire fences;
- .12 body of water close by;

The Contractor shall process to a risk assessment of the site to validate this information and see if other risks are present on the site. He must include in its prevention program all risks that have been identified.

1.12 SPECIFIC REQUIREMENTS FOR THE HEALTH AND SAFETY OF OCCUPANTS AND PUBLIC

- .1 The worksite is occupied by employees and/or the public during the following times: 8:00-17:00. The Contractor shall consider the following specific requirements for the protection of employees and / or the public: Delimitation of the work site to restrict access.
- .2 These requirements must be included in the Contractor's site-specific safety plan as well as any other measures provided by the Contractor to protect the health and safety of employees and / or the public on the site.

1.13 UNFORESEEN HAZARDS

- .1 Whenever a source of danger not defined in the specifications or identified in the preliminary construction site inspection arises as a result of or in the course of the work, the Contractor must immediately suspend work, notify the person responsible for health and safety on the construction site, take appropriate temporary measures to protect the workers and the public and notify Departmental representative, both verbally and in writing. Then the Contractor must do the necessary modifications to the prevention program or apply the security measures required in order to resume work.

1.14 PERSON IN CHARGE OF HEALTH AND SAFETY

- .1 If the construction site meets the requirements of article 2.5.3 of the *Code de la sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the construction industry), the Contractor needs to hire a competent person authorized as a safety officer and appoint this person full time from the beginning of the work. This person's tasks shall solely be dedicated to the management of health and safety on the construction site. This safety officer must have the following qualifications:
 - .1 have a safety officer certificate issued by the CNESST;
 - .2 have site-related working experience of at least 10 years specific to the activities associated with the present project;
 - .3 have working knowledge of occupational health and safety regulations in the workplace;
 - .4 be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter the construction site to perform work;
 - .5 be responsible for implementing, enforcing in detail and monitoring site-specific Contractor's Health and prevention program;

- .6 be on construction site at all times during execution of work;
- .7 inspect the work and ensure compliance with all regulatory requirements and those indicated in the contract documents or the site-specific prevention program.
- .8 Keep a daily log of actions taken and submitting a copy to Departmental representative each week.

The safety officer's certificate shall be submitted to the Departmental representative before the start of the work.

- .2 When the hiring of a safety officer is not required or if this person is hired by the Departmental representative, the Contractor shall designate a competent person to supervise and take responsibility for health and safety, no matter the size of the construction site or how many workers are present at the workplace. This person shall be on construction site at all times and be able to take all necessary measures to ensure the health and safety of persons and property at or in the immediate vicinity of the construction site and likely to be affected by any of the work. The Contractor shall submit the name of this person to the Departmental representative before the start of work.

1.15 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on construction site in accordance with Acts and Regulations of the Province, and in consultation with Departmental representative.
- .2 At a minimum, the following information and documents must be posted in a location readily accessible to all workers:
 - .1 notice of construction site opening;
 - .2 identification of principal Contractor;
 - .3 company OSH policy;
 - .4 site-specific prevention program;
 - .5 emergency plan;
 - .6 minutes of worksite committee meetings;
 - .7 names of worksite committee representatives;
 - .8 names of the first-aid attendants;
 - .9 action reports and correction notices issued by the CNESST.

1.16 INSPECTION OF THE CONSTRUCTION SITE AND CORRECTION OF NON-COMPLIANCES

- .1 Inspect the construction site and complete the construction site inspection checklist and submit it to the Departmental representative in accordance with the article "ACTION AND INFORMATIONAL SUBMITTALS" in this section.

- .2 Immediately take all necessary measures to correct any situations deemed non-compliant during the inspections mentioned in the previous paragraph or noticed by the authorities having jurisdiction or the Departmental representative or his agent.
- .3 Submit to Departmental representative written confirmation of all measures taken to correct the situation in case of non-compliance in matters pertaining to health and safety.
- .4 The Contractor shall give the safety officer or, where there is no safety officer, the person assigned to safety and health responsibilities, full authority to order cessation and resuming of work as and when deemed necessary or desirable in the interests of safety and health. This person should always act so that the safety and health of the public and construction site workers and environmental protection take precedence over cost and scheduling considerations.
- .5 The Departmental representative or his agent may order cessation of work if the Contractor does not make the corrections needed to conditions deemed non-compliant in matters pertaining to health and safety. Without limiting the scope of the preceding articles, the Departmental representative may order cessation of work if, in his view, there is any hazard or threat to the safety or health of construction site personnel or the public or to the environment.

1.17 PREVENTION OF VIOLENCE

- .1 Health and safety management of Public Works and Government Services Canada construction sites includeS the implementation of measures designed to protect the psychological health of all persons who access the construction site where the work is taking place. Consequently, in addition to physical violence, verbal abuse, intimidation and harassment are not tolerated on the construction site. Any person who demonstrates such actions or behaviors will receive a warning and/or could be definitely expelled from the construction site by the Departmental representative.

1.18 POWDER ACTUATED DEVICE

- .1 Use powder actuated devices only after receipt of written permission from Departmental representative.
- .2 Any person using an explosive actuated tool shall hold a training certificate and meet all requirements of Section 7 of the *Code the sécurité pour les travaux de construction* (S- 2.1, r. 4). (Safety code for the construction industry)
- .3 Any other explosive-actuated device shall be used in accordance with the manufacturer's directions and applicable standards and regulations.

1.19 USE OF PUBLIC ROADS

- .1 Where it is necessary to encroach on a public road for operational reasons or to ensure the security of the workers, the occupants or the public (for example: the use of scaffolding, cranes, excavation work, etc.), the Contractor shall obtain at his own expense any authorizations and permits required by the competent authority.
- .2 The Contractor shall install at his own expense any signage, barricades or other devices needed to ensure the safety and security of the public and the Contractor's own facilities.

1.20 LOCKOUT-TAGOUT

- .1 For all work on electrically or otherwise energized equipment, the Contractor shall draw up and implement a general lockout-tagout procedure and submit it to the Departmental representative.
- .2 Supervisors and all workers concerned by work requiring lockout-tagout must have received training on lockout-tagout procedures by a recognized organization; Contractor shall submit training certificates to the Departmental representative.
- .3 Before starting the lockout-tagout procedure of a piece of equipment on an occupied site, Contractor must coordinate his work with the representative of the site if the interruption of the power sources can have an impact on the operations of the site or on its occupants.
- .4 Contractor must designate a qualified person as responsible for the lockout-tagout and must make sure that that person prepares a lockout-tagout data sheet for each piece of equipment involved. The lockout-tagout data sheet must be submitted to the Departmental representative at least 48 hours before the beginning of the work. The Departmental representative will review the data sheet with the representative of the site if the work takes place in an existing building. The data sheets for lockout-tagout must contain at least the following information:
 - .1 description of work to carry out;
 - .2 identification, description and location of the circuit and/or equipment to lockout-tagout;
 - .3 identification of energy sources that feeds the equipment;
 - .4 identification of each cutout point;
 - .5 sequence of lockout-tagout and the release of residual energy as well as the sequence of unlocking;
 - .6 list of material needed for the lockout-tagout;
 - .7 method of verification of zero energy implementation;
 - .8 name and signature of the person who prepared the data sheet.

When required by the Departmental representative, Contractor must record all this information on the site's representative form.

- .5 At the time of lockout-tagout, the person responsible must date the data sheet and ensure that each worker involved in the work on the circuit equipment to lockout-tagout puts his name on the data sheet and signs it.

1.21 ELECTRICAL WORK

- .1 Contractor shall ensure that all electrical work is executed by qualified employees in accordance with the provincial regulation respecting vocational training and qualification.
- .2 Contractor shall respect all requirements of standard CSA Z462 *Workplace Electrical Safety Standard*.
- .3 No repairs or alterations shall be carried out on any live equipment except where complete disconnection of the equipment is not feasible.
- .4 Contractor shall respect all requirements prescribed in paragraph "LOCKOUT-TAGOUT" in this section.
- .5 Contractor shall advise in writing the Departmental representative of all the work that cannot be done with de-energized equipment and obtain his authorization. Contractor shall demonstrate to the Departmental representative that it is impossible to do the work with de-energized equipment and provide all the information necessary to request and obtain an energized electrical work permit (indicate working procedures, arc flash hazard analysis, protective perimeter, protective equipment, etc.) before the beginning of the work, excluding for the exceptions indicated in standard CSA Z462 Workplace electrical safety.
- .6 The energized electrical work permit on must contain at least the following elements:
 - description of the circuit and equipment and its location;
 - justification for having to do the work in an energized condition;
 - description of safe work practices to apply;
 - results of the shock hazard analysis;
 - limit of the protective perimeter against electric shocks;
 - results of the arc flash hazard analysis;
 - description of the arc flash protection boundary;
 - description of the personal protective equipment required;
 - description of the means to limit access to unqualified persons;
 - proof that an information session has been carried out;

- approval signature of the energized electrical work (by a person in authority or by the department representative).
- .7 If for the operational requirements of the occupants of the site the representative of the site requires that the Contractor performs work in an energized condition, the Contractor shall obtain all the information required to request and obtain an energized electrical work permit (indicate working procedures, arc flash hazard analysis, protective perimeter, protective equipment, etc.) and have it signed by the representative of the site assigned by the Departmental representative before the beginning of the work.

1.22 ASBESTOS EXPOSURE

It is not anticipated that the work covered by the present specifications involves the manipulation of materials containing asbestos; however, if the Contractor or the Departmental representative or his agent discover materials which are susceptible of containing asbestos, the Contractor must immediately stop the work and advise the Departmental representative. If more investigation demonstrates that the materials do contain asbestos, the Contractor shall comply with the following requirements.

Prior to starting any work likely to emit asbestos dust, the Contractor must:

1. Provide a written procedure for the work, identifying the risk level of the work (low, moderate, high), as defined in section 3.23 of the *Code de la sécurité pour les travaux de construction* S-2.1, r- 4, (Safety code for the construction industry). This procedure must take into account all the requirements of that section 3.23.
2. Submit certificates that demonstrate that all workers involved in the work have received training on asbestos hazards and on the procedure required in the preceding paragraph.
3. Demonstrate that he has all the material and equipment required on hand to respect the procedure and for safely conducting the work.

1.23 FUNGAL CONTAMINATION

It is not anticipated that the work covered by the present specifications involves the manipulation of materials contaminated by mould; however, if the Contractor or the Departmental representative or his agent discover materials which are susceptible of being contaminated by mould, the Contractor must immediately stop the work and advise the Departmental representative. If more investigation demonstrates that the materials do contain mould, the Contractor shall comply with the following requirements.

Prior to starting any work where workers are likely to be in contact with materials contaminated by mould, the Contractor must:

1. Provide a written procedure for the work which respects all the requirements of the *Code de sécurité pour les travaux de construction* S-2.1, r- 4, (Safety code for the construction industry), as well as the requirements indicated in the document “*Mould Guidelines for the Canadian Construction Industry*” published by the Canadian Construction Association (<http://www.cca-acc.com/documents/electronic/cca82/cca82.pdf>).
2. Demonstrate that he has all the material and equipment required on hand to respect the procedure and for safely conducting the work.

1.24 EXPOSURE TO SILICA

For any interior or exterior work generating silica, the Contractor must respect the following requirements, in addition to those in the *Code de sécurité pour les travaux de construction* S-2.1, r.4 (Safety code for the construction industry).

1. Work in wet environment or use tools with the inflow of water in order to reduce dustiness, if not, collect dust at the source and retain it with a high-efficiency filters not to propagate dust in the environment.
2. Clean surfaces and tools with water, never with compressed air.
3. Sand and pickle surfaces by using an abrasive containing less than 1% of silica (also called amorphous silica).
4. Install shields or other containment device to prevent silica dust from migrating toward other workers or the public.
5. Wear individual respiratory and ocular protection equipment during all the operations that could generate silica dust in accordance with the requirements of the *Code de sécurité pour les travaux de construction*, S-2.1, r.4 (Safety code for the construction industry).
6. Wear coveralls to prevent contamination outside the construction site.
7. Do not eat, drink, or smoke in a dusty environment.
8. Wash the hands and the face before drinking, eating or smoking.

1.25 LEAD-BASE PAINT REMOVAL

Prior to all work where workers are likely to handle materials containing lead-base paint or other substances containing lead, the Contractor must:

1. Provide a written procedure for the work which respects all the requirements of the *Code de sécurité pour les travaux de construction* S-2.1, r- 4, (Safety code for the construction industry), as well as the requirements indicated in the document “*Guideline for Lead on Construction Projects*” published by the Ontario Ministry of Labour (http://www.labour.gov.on.ca/english/hs/pdf/gl_lead.pdf). If there is a discrepancy between the Québec regulation and the Ontario document, the most stringent requirement shall apply.
2. Demonstrate that he has all the material and equipment required on hand to respect the procedure and for safely conducting the work.

1.26 EXPOSURE TO ANIMAL’S FECAL DROPPINGS

Prior to all work where workers are likely to come in contact with materials contaminated by animal’s fecal droppings, the Contractor must:

1. Provide a written procedure for the work which respects all the requirements of the *Code de la sécurité pour les travaux de construction* S-2.1, r- 4, (Safety code for the construction industry), as well as the requirements indicated in the document “*Des fientes de pigeons dans votre lieu de travail: méfiez-vous*” (Pigeon droppings in your workplace: Beware” published by the CNESST (http://www.csst.qc.ca/publications/100/Documents/DC100_1331_1web2.pdf)
2. Demonstrate that he has all the material and equipment required on hand to respect the procedure and for safely conducting the work.

1.27 RESPIRATORY PROTECTION

1. Contractor must ensure that all workers who must wear a respirator as part of their duties have received training for that purpose as well as fit testing of their respirator, in accordance with CSA Standard Z94.4 *Selection, use and care of respirators*. Submit the certificates of the fit testingS to the Departmental representative on demand.

1.28 FALL PROTECTION

1. Plan and organize work so as to eliminate the risk of fall at the source or ensure collective protection, thereby minimizing the use of personal protective equipment. When personal fall protection is required, workers must use a safety harness that complies with CSA standard CAN/CSA Z-259.10 M90. A safety belt must not be used as fall protection.

2. Every person using an elevating platform (scissors, telescopic mast, articulated mast, rotative mast, etc.) must have a training regarding this equipment.
3. The use of a safety harness is mandatory for all elevating platforms with telescopic, articulate or rotative mast.
4. Define the limits of the danger zone around each elevating platform.
5. All openings in a floor or roof must be surrounded by a guardrail or provided with a cover fixed to the floor able to withstand the loads to which it could be exposed, regardless of the size of the opening and the height of the fall it represents.
6. Everyone who works within two metres from a fall hazard of three metres or more must use a safety harness in accordance with the requirements of the regulation, unless there is a guardrail or another device offering an equivalent safety.
7. Despite the requirements of the regulation, the Departmental representative may require the installation of a guardrail or the use of a safety harness for specific situations presenting a risk of fall less than three metres.

1.29 SCAFFOLDINGS

In addition to the requirements of the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry), the Contractor who uses scaffolding must respect the following requirements:

Foundation

1. Scaffolding shall be installed on a solid foundation so that it does not slip or rock.
2. Contractors wishing to install scaffolding on a roof, overhang, canopy or awning shall submit their calculations and loads, as well as plans signed and sealed by an engineer to the Departmental representative and obtain his authorization before beginning installation.

Assembly, bracing and mooring

1. All scaffolding shall be assembled, braced and moored in accordance with the manufacturer's instructions and the provisions of the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry).

2. Where a situation requires the removal of part of the scaffolding (e.g., crosspieces), the Contractor shall submit to the Departmental representative an assembly procedure signed and sealed by an engineer certifying that the scaffolding assembled in that manner will allow the work to be done safely given the loads to which it will be subject.
3. For scaffolding where the span between two supports is greater than three metres, the Contractor shall provide the Departmental representative an assembly plan signed and sealed by an engineer.

Protection against falls during assembly

1. Workers exposed to the risk of falling more than three metres shall be protected against falls at all times during assembly.

Platforms

1. Scaffolding platforms shall be designed and installed in accordance with the provisions of the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry).
2. If planks are used, they shall be approved and stamped in accordance with section 3.9.8 of the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry)
3. Scaffolding of four sections (or six metres) high or more shall have a full platform covering the entire surface between the putlogs every three metres high or fraction thereof, and the components of that platform shall not be moved at any time to create an intermediate landing.

Guardrails

1. A guardrail shall be installed on every landing.
2. Cross braces shall not be considered as guardrails.
3. If the platforms are not covering the entire surface between the putlogs, the guardrail must be installed just above the edge of the platform so that there is no empty horizontal space between the platform and the guardrail.
4. Where scaffolding has four sections (or six metres) high or more and full platforms are required, the guardrails shall be installed on each landing at the start of work and shall remain in place until the work is completed.

Access

1. The Contractor shall ensure that access to the scaffolding does not compromise worker safety.
2. Where the platforms of the scaffolding are comprised of planks, ladders shall be installed in such a way that planks extending beyond the platform do not block the way up or down.

3. Notwithstanding the provisions of the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry), stairs shall be installed on all scaffoldings that have six or more rows of uprights or is six sections (or nine metres) high or higher.

Protection of the public and occupants

1. When scaffolding is installed in a zone accessible to the public, the Contractor shall take the necessary measures to prevent the public from having access to them and, if applicable, to the work or storage area located in the vicinity of these scaffolding.
2. Contractor must install covered walkways, nets or other similar devices to protect workers, the public and the occupants against falling objects. The means of protection must be approved by the Departmental representative.

Engineering plans

1. In addition to those required by the *Code de sécurité pour les travaux de construction* (Safety code for the construction industry), the Departmental representative reserves the right to require engineering plans for other types or configurations of scaffolding.
2. A plan signed and sealed by an engineer is required for all scaffolding that will be covered with a canvas, a tarpaulin or any other material that has wind resistance.
3. A certificate of conformity signed by an engineer is required in all cases where an engineering plan is required for the installation and this, before anybody uses the facility. A copy of these documents must be available on the construction site at all times.

1.30 LIFTING LOADS WITH CRANE OR BOOM TRUCK

1. Unless specified otherwise, the Contractor must prepare a hoisting plan and submit it to the Departmental representative for all lifting operations done with a crane or a boom truck at least 5 days before these lifting operations begin. The hoisting plan must contain at a minimum the information listed at the end of this article.
2. The hoisting plan must be signed and sealed by an engineer for the following lifting operations:
 - a. lifting of concrete panels;
 - b. lifting mechanical/electrical equipment on a roof or on the floor of a building;
 - c. lifting of loads encroaching on the public road;
 - d. lifting large dimension or very heavy loads;
 - e. all other lifting operation, in accordance with the requirements of the Departmental representative.
3. In addition to the above requirements, the Contractor must plan the hoisting operations in a way as to avoid that the loads pass over the occupied zones on the site. When there is no alternative, the hoisting plan must absolutely be signed and sealed by an engineer and must guarantee the security of the occupants in that zone; the plan must also be approved by the Departmental representative. The Departmental representative can, if he deems necessary, require that the work be done at night or on weekends.

4. Upon the beginning of the work on the construction site, the Contractor must submit the list of the hoisting plans anticipated for the whole project to the Departmental representative. That list shall be updated as needed if changes occur during the work.
5. In addition to the mechanical service inspection certificate, the annual inspection certificate and the crane logbook must be aboard all cranes and boom truck cabs.
6. The entire lifting area shall be marked off to prevent the entry of non-authorized persons.
7. The Contractor shall carefully inspect all of the slings and lifting accessories and make sure that those in poor condition are destroyed and scrapped.
8. Compressed-gas cylinders shall be lifted with a basket specially designed for this purpose.

MINIMUM CONTENT OF HOISTING PLAN

- Sketch indicating at a minimum, the location of the crane, the surrounding facilities, the zone covered by the hoisting operations, the pedestrian's pathways and vehicular routes, the security perimeter, etc.
- Weight of loads
- DimensionS of loads
- List of hoisting devices and weight of each
- Total weight lifted
- Maximum height of obstacles to clear
- Height of loads lifting relative to the surface of the roof (in the case of loads to be placed on roofs)
- Use of guide cables
- Type of crane used
- Crane capacity
- Boom length
- Boom angle
- Crane's radius of action
- Deployment of stabilizers

- Percentage usage of the crane's capacity
- Verification confirmation of hoisting equipment
- Identification of the crane operator and the person responsible for the hoisting operations with date and signatures

1.31 HOT WORK

Hot work means any work where a flame is used or a source of ignition may be produced, i.e., riveting, welding, cutting, grinding, burning, heating, etc.

1. Before the beginning of each shift of work and for each sector, the Contractor must obtain a "Hot Work Permit" emitted by the person responsible for the site.
2. A working portable fire extinguisher suitable to the fire risk shall be available and easily accessible within a 5 m radius from any flame, spark source or intense heat.
3. The Contractor must appoint an individual to do continuous monitoring of the fire risks for a period of one (1) hour after the end of the shift of hot work. This individual shall sign the section for this purpose on the permit and give it to the person in charge of the construction site after the one-hour period.
4. When the hot work is done in areas where there are combustible materials or where the walls, ceilings or floors are made of or covered with combustible materials, a final inspection of the work area must be scheduled four (4) hours after the work has finished. Unless specified otherwise by the Departmental representative, the Contractor must assign a person to carry out this monitoring.

Welding and cutting

In addition to the requirements prescribed in the preceding paragraphs, the Contractor must respect the following requirements:

1. Welding and cutting work must be carried out in accordance with the requirements of the *Code de Sécurité pour les travaux de construction, S-2.1, r.4* (Safety code for the construction industry) and CSA standard W117.2, Safety in Cutting, Welding and Allied Processes.
2. Air extraction system with filters must be used for all welding and cutting work performed inside.
3. Stop all activities producing flammable or combustible gas, vapours or dust in the vicinity of the welding or cutting work.
4. Store all compressed gas cylinder on a fireproof fabric and make sure that the room is well ventilated.
5. Store all oxygen cylinders more than 6 metres from a flammable gas cylinder (ex: acetylene) or a combustible such as oil or grease, unless the oxygen cylinder is

separated from it by a wall made of non-combustible material as mentioned in the article 3.13.4 of the *Code de sécurité pour les travaux de construction, S-2, r. 6* (Safety code for the construction industry)

6. Store the cylinders far from all heat sources.
7. Not to store the cylinders close to the staircases, exits, corridors and elevators.
8. Do not put acetylene in contact with metals such as silver, mercury, copper and alloys of brass having more than 65% copper, to avoid the risk of an explosive reaction.
9. Check that welding equipment with electric arc has the necessary tension and are grounded.
10. Ensure that the conducting wires of the electric welding equipment are not damaged.
11. Place the welding equipment on a flat ground away from the bad weather.
12. Install fireproof canvas when the welding work is done in a superposition and where there is the risk of falling sparks.
13. Move away or protect the combustible materials which are closer than 15 metres from the welding work.
14. Prohibition to weld or cut any closed container.
15. Do not perform any cutting, welding or work with a naked flame on a container, a tank, a pipe or other container containing a flammable or explosive substance unless:
 - a. they have been cleaned and air samples indicating that work can be done without danger has been taken; and
 - b. provisions to ensure the safety of the workers have been made

1.32. ROOFING WORK

Protection against fall from heights

1. Installation of guardrails is mandatory at all times; however, the installation of a warning line is allowed to define the limits of the work zones provided that all the requirements of the articles 2.9.4.0 and 2.9.4.1 of the *Code de sécurité pour les travaux de construction* (Safety code for the Construction Industry) are respected.
2. The guardrails must remain in place until the end of the project. The Departmental representative will authorize their dismantling when he can confirm that all the work, inspections and corrections have been made.
3. Workers installing guardrails must wear safety harnesses.
4. Workers installing and modifying guardrails or flashing shall wear safety harnesses in the event guardrails must be moved temporarily.
5. Workers shall wear safety harnesses when receiving material and giving directions to the crane operator next to a drop.
6. Safety harnesses shall be worn when carrying out work next to a drop where collective protection is not sufficiently safe.
7. The Contractor shall provide a fastening method and safety cable system compliant with section 2.10.12 of the *Code de sécurité pour les travaux de construction (L.R.Q., S-2.1, r.4)* (Safety code for the Construction Industry) for each construction site or location.

Lifting of materials

1. For all winch installations, the Contractor shall provide the Departmental representative with the installation method recommended by the manufacturer. If unavailable, the Contractor shall then provide an installation procedure signed and sealed by an engineer. The installation procedure must take into account load-bearing capacity, the amount, weight and location of counterweight and any other detail that may affect the capacity and stability of the device.
2. The Contractor shall carefully inspect all of the slings and lifting accessories and make sure that those in poor condition are destroyed or scrapped.
3. Compressed-gas cylinders shall be lifted with a basket specially designed for this purpose.
4. In all cases where a crane or boom truck is used, the Contractor must respect the requirements of the paragraph Lifting Loads with Crane or Boom Truck, in this section.

Protection against burns

1. Individuals assigned to the boilers shall wear long sleeves, safety glasses and a face shield when filling the boilers.
2. Individuals working with asphalt or other hot liquids shall wear gloves, long sleeves and safety glasses.

Protection against fire

1. The storage and use of propane cylinders shall comply with the standard CAN/CSA-B149.2, *Propane Storage and Handling Code*. The cylinders shall be stored outdoors, in a safe place, away from any unauthorized handling, in a storage cabinet specially designed for this purpose. The cylinders shall be securely kept upright and locked at all times in a place where no vehicles are allowed unless the cylinders are protected by barriers or similar protection.
2. The number of propane cylinders on the roof shall not exceed the number of cylinders necessary for a day's work, and cylinders shall at all times be secured upright or held in a cart designed for this purpose.
3. All hot work (burning, heating, riveting, welding, cutting, grinding, etc.) must be done in accordance with paragraph "Hot Work" in this section.

Material and waste management

1. On the roof, light material and sheet material shall be kept in containers or be securely fastened. In the event this requirement is disregarded in the slightest way, the Departmental representative may disallow the storage of materials on the roof.
2. Waste shall be discarded as produced using a waste chute or appropriate containers. The Contractor shall provide the means to prevent waste from being carried away by the wind.

3. All waste must be removed from the roof at the end of shifts.
4. Unless otherwise authorized by the Departmental representative, all waste bins must be placed at least 3 m from any structure or building.

Protection of occupants and the public

1. Contractor must install covered passageways, nets or other devices above the entrances and the exits of the building to protect the workers, the public and the occupants against falling object. The means of protection must be approved by the Departmental representative.
2. A safety perimeter on the ground must be placed under the work zone in order to protect the workers, the public and the occupants.
3. The ground construction site, material handling area and boiler area shall be clearly sealed off to prevent occupants or the public from accessing the construction site and areas.
4. Before installing any device that may emit gas or fumes, the Contractor shall receive authorization from the person in charge of the construction site, who shall make sure that there is no risk of gas or fumes infiltrating the building's ventilation system.

1.33. STEEL STRUCTURE ERECTION OR DISMANTLING WORK

- .1 In addition to respecting section 3.24 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry), the Contractor must also respect the requirements described in the following paragraphs.
- .2 Contractor must submit the following documents to the Departmental representative before the beginning of steel structure erection work:
 - .1 Erecting procedures in accordance with article 3.24.10 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry);
 - .2 rescue procedures for the release of a worker suspended in a safety harness within a maximum of 15 minutes; procedures must be adapted to the construction site and in accordance with article 3.24.4 of that same code; the procedure must be accompanied by a written confirmation that it has been tested;
 - .3 statement from an engineer that the anchor rods have been installed in accordance with the anchoring plan as required by the article 3.24.12 of that same code;
 - .4 hoisting procedures in cases where the lifting is done in one of the ways described in the article 3.24.15 of that same code;
 - .5 name of the individual identified as rescuer and his rescue training certificate;
 - .6 name of the individual identified as first-aid attendant and his first-aid training certificate.

- .3 The Contractor must make sure that the following documents are available for consultation on construction site at all times:
 - .1 Steel structure manufacturer's erection plan in accordance with the requirements of article 3.24.9 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry);
 - .2 Column anchor rodS's anchoring plan in accordance with the requirements of article 3.24.11 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry).

1.34. WORK NEAR BODIES OF WATER

1. For all work done near a body of water (such as work above water, work on a wharf, work on the edge of a watercourse, etc.), the Contractor must respect the requirement of the following paragraphs in addition to those of *Code de sécurité pour les travaux de construction* (Safety code for the Construction Industry).
2. The Contractor must plan his work in a way to implement safety measures to prevent any worker from falling in the water. The use of these measures should be favoured over the wearing of a life jacket.
3. Submit the following documents to the Departmental representative before the beginning of the work:
 - a. description of the body of water;
 - b. description of the work done next to this body of water;
 - c. plan of transportation on water adapted to the work and to the characteristics of the body of water;
 - d. rescue plan adapted to the work and to the characteristics of the body of water;

Each of the document listed above must contain at a minimum the information required in section 11 of the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry).

If there is the possibility that all or part of the work can be done during the winter, the safety measures included in the documents required above must be adapted accordingly.

4. The Contractor must submit to the Departmental representative the certificate of training required in article 11.2 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry) for the following individuals:
 - a. the person assigned to prepare the documents required in the preceding paragraph; and
 - b. each person responsible for the transport or rescue operations

5. If the rescue plan stipulates the use of a vessel, the Contractor must submit to Departmental representative the competency card or certificate for the individuals in the rescue team for his work, issued by Transport Canada.
6. The Contractor must include in his weekly inspection checklist the devices required in the articles 11.4 and 11.5 du *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry).
7. Ensure that a rescue vessel moored and in the water is available at each place where a worker may fall in the water. However, a vessel may serve more than one workplace on the same construction site provided the distance between any of these workplaces and the vessel is less than 30 m.
8. Where the construction site is a wharf, a pier, a quay or any similar structure, a ladder with at least two (2) rungs below the surface of the water shall be installed on the front of the structure every 60 m.

1.35. INTERIOR USE OF INTERNAL COMBUSTION ENGINES

1. In addition to respecting article 3.10.17 of the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry), the Contractor must also respect the requirements described in the following paragraphs.
2. The use of a gas-powered equipment inside a building is prohibited even if the building is provided with openings.
3. The use of other equipment powered by an internal combustion engine inside a building must be submitted to the approval of the Departmental representative.
4. For the use of any piece of equipment powered by an internal combustion engine inside a building, even if the building is provided with openings, the Contractor must install a ventilation system able to maintain the concentrations of toxic gases below the regulatory values. The stale air shall be exhausted outside the building.
 - a. Before using equipment powered by an internal combustion engine, the Contractor must plan and write the following:
 - b. number of fans to install;
 - c. power of the fans;
 - d. location of the fans;
 - e. dimensions of the openings that will be open during the work.
5. During the operation of equipment with internal combustion engine, the Contractor must measure the concentrations of carbon monoxide and nitrogen oxides in the work area and at the breathing area of the workers; the concentration levels measured must be recorded in a register every 30 minutes that must be available for consultation.

6. If work is in an occupied building, the Contractor must also measure the concentrations of carbon monoxide and nitrogen oxides in the rooms next to the work area and the concentration levels measured must be recorded in a register every 30 minutes.
7. If the carbon monoxide or nitrogen oxides detector alarm goes off during the work, the Contractor must stop the work and take the corrective measures required before resuming the work.
8. A portable fire extinguisher must be available at all times in the work area during the use of equipment with internal combustion engines.
9. The equipment must be maintained at a safe distance from all combustible material.
10. The storage of fuel for any equipment with internal combustion engine is prohibited inside a building.

1.36. TEMPORARY HEATING

1. In addition to respecting section 3.11 of the *Code de sécurité pour les travaux de construction* (S-2.1, r.4) (Safety code for the Construction Industry), the Contractor must also respect the requirements described in the following paragraphs.
2. A portable fire extinguisher must be available at all times near the heating units, no matter what type of heating is used.
3. The heating units must always be used in accordance with the manufacturer's specifications.
4. If applicable, the canvas or tarpaulins used next to the heating units must be solidly fixed so as not to be projected on the heaters, on the pipes connected to the heaters or on any other heat source.
5. The gas cylinders must be installed in a way that they are protected from vehicle and other equipment traffic.
6. For the use of heating units other than electric, the Contractor must install a carbon monoxide detector in the work area, next to the heating units and/or the workers, throughout the course of the heating period. The Contractor must immediately apply the corrective measures required to the heating units if the detector's alarm goes off.
7. The Contractor must ensure a minimum surveillance of the heating units outside the hours of work (nights and weekends). He must submit a surveillance plan to the Departmental representative before the use of the heating units.

1.37. WORK NEAR OVERHEAD POWER LINES

- .1 When there is an overhead power line in the work zone and that the Contractor chooses to apply paragraph b) of article 5.2.2 of the *Code de sécurité pour les travaux de construction* (2.1, r.4) (Safety code for the Construction Industry), a copy of the agreement with the electrical power company and a copy of the work process, required in the article 5.2.2 b), must be submitted to the Departmental representative before the beginning of the work in relation to these documents.

1.38. HEALTH AND SAFETY SUBORDINATION AGREEMENT

Project: _____ **Address:** _____

EXTERNAL CONTRACTOR

I hereby agree to submit to the authority of (name of the Principal Contractor's business) _____, which is the Principal Contractor for the project indicated above during the entire duration of our work on the construction site. Accordingly, I confirm that I have reviewed the Principal Contractor's prevention program, and I agree to:

- inform my employees of the content of the Principal Contractor's prevention program and ensure that its content is complied with at all times;
- apply the prevention program that is specific to the activities that we carry out under this project;
- inform the Principal Contractor of my actions or dealings on the construction site and obtain the Principal Contractor's agreement before the start of work; and
- follow the health and safety directives provided by the representative of the Principal Contractor on the construction site and, depending on requirements, attend training sessions and health and safety meetings organized by the representative of the Principal Contractor.

Name of representative: _____

Name of business: _____

Description of work to be done on the construction site: _____

Approximate dates of work (start-end): _____

Signature: _____ Date: _____

PRINCIPAL CONTRACTOR

I hereby agree to allow the business (name of external contractor) _____ to perform the work under this project indicated above and, as Principal Contractor, to take the necessary steps to protect the health and safety of workers on the construction site. Should the Contractor repeatedly refuse or fail to comply with my directives, I agree to inform PWGSC's Departmental representative of this and to provide documentary evidence of my actions or dealings with the Contractor.

Name of representative: _____

Name of the Principal Contractor's business: _____

Signature: _____ Date: _____

Submit a completed and signed copy to PWGSC's Departmental representative

1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-1994, Stipulated Price Contract.
- .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 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

1.4 HOISTING

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

1.5 ELEVATORS

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Co-ordinate use with Department Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

1.6 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.

1.7 SECURITY

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

1.8 OFFICES

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

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.10 SANITARY FACILITIES

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

1.11 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by Department Representative.
- .2 Construction sign 1m x 2m m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, Contractor and Subcontractor, of design style Department Representative.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.
- .5 Provide project identification site sign comprising foundation, framing, and 1200mm x 2400 mm signboard as detailed and as described below.
 - .1 Foundations: 15 MPa concrete to CSA-A23.1 minimum 200 mm x 900 mm deep.
 - .2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.
 - .3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.
 - .4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CAN/CGSB 1.189.
 - .5 Fasteners: hot-dip galvanized steel nails and carriage bolts.
- .6 Locate project identification sign Department Representative and construct as follows:
 - .1 Build concrete foundation, erect framework, and attach signboard to framing.
 - .2 Paint surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
 - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .7 Direct requests for approval to erect Contractor signboard to Department Representative. For consideration general appearance of Contractor signboard must conform to project identification site sign. Wording in both official languages.
- .8 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .9 Maintain approved signs and notices in good condition for duration of project, and dispose of offsite on completion of project or earlier if directed by Department Representative.

1.12 CLEAN-UP

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

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 CSA Group (CSA)
 - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.2 INSTALLATION AND REMOVAL

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

1.3 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.

1.4 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions 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.

1.5 ACCESS TO SITE

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

1.6 FIRE ROUTES

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

END OF SECTION

1 General

1.1 SECTION INCLUDES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALIFICATIONS

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

2 Products

2.1 MATERIALS

- .1 Patching Materials: If possible, use the same materials found in the existing conditions, except in fire-resistance rated materials and assemblies.
- .2 Materials Visible from the Floor Area: Use materials that visually match existing adjacent surfaces, and match existing functional performance.

3 Execution

3.1 COMMON INSTALLATION/APPLICATION/ERECTION REQUIREMENTS

- .1 Fit several parts together, to integrate with other Work.
- .2 Remove and replace defective and non-conforming Work.

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

.9

3.2 BRACING AND ANCHORING

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

3.3 ADJUSTING

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

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008, Stipulated Price Contract.
- .2

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Department representative or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Department Representative. Do not burn waste materials on site, unless approved by Department representative.
- .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 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.

1.3 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris including that caused by Department representative or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Department Representative. Do not burn waste materials on site, unless approved by Department Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .8 Clean lighting reflectors, lenses, and other lighting surfaces.
- .9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .10 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .11 Clean roofs, downspouts, and drainage systems.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor 's commitment to reduce and divert waste materials from landfill and includes the following:
 - .1 Preparation of a Draft Construction Waste Management Plan that will be used to track the success of the Construction Waste Management Plan against actual waste diversion from landfill.
 - .2 Preparation of a Construction Waste Management Plan that provides guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.
 - .3 Preparation of monthly progress reports indicating cumulative totals representing progress towards achieving diversion and reduction goals of waste materials away from landfill and identifying any special programs, landfill options or alternatives to landfill used during construction.
 - .4 Preparation of a Construction Waste Management Report containing detailed information indicating total waste produced by the Project, types of waste material and quantity of each material, and total waste diverted and diversion rates indicated as a percentage of the total waste produced.
- .2 Department representative has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors be employed by the Contractor.

1.2 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, repair 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.
- .18 Construction Waste Management Plan: A project related plan for the collection, transportation, and disposal of the waste generated at the construction site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM E1609 01, Standard Guide for Development and Implementation of a Pollution Prevention Program
- .2 Recycling Certification Institute (RCI)
 - .1 RCI Certification Construction and Demolition Materials Recycling

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the Project, and ensure that requirements of the Construction Waste Management Plan are followed.
- .2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance with Section Section 01 31 19 - Project Meetings before starting any Work of the Contract attended by the Department representative, Contractor, affected Subcontractor 's and to discuss the Contractor 's Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit required information in accordance with Section Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Draft Construction Waste Management Plan (Draft CWM Plan): Submit to a preliminary analysis of anticipated site generated waste by listing a minimum of five (5) construction or demolition waste streams that have potential to generate the most volume of material indicating methods that will be used to divert construction waste from landfill and source reduction strategies; will provide commentary before development of Contractor 's Construction Waste Management Plan.
 - .2 Construction Waste Management Plan (CWM Plan): Submit a CWM Plan for this Project before any waste removal from site and that includes the following information:
 - .1 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into CWM Plan.

- .2 Alternative Waste Disposal: Prepare a listing of each material proposed to be salvaged, reused, recycled or composted during the course of the Project, and the proposed local market for each material.
- .3 Landfill Materials: Identify materials that cannot be recycled, reused or composted and provide explanation or justification; energy will be considered as a viable alternative diversion strategy for these materials where facilities exist and are operated in accordance with LEED Construction and Demolition Waste Management requirements.
- .4 Landfill Options: The name of the landfill where trash will be disposed of; landfill materials will form a part of the total waste generated by the Project.
- .5 Materials Handling Procedures: A description of the means by which any recycled waste materials will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
- .6 Transportation: A description of the means of transportation of the recyclable materials, whether materials will be site separated and self hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site, and destination of materials.

1.6 QUALITY ASSURANCE

- .1 Resources for Development of Construction Waste Management Report (CWM Report): The following sources may be useful in developing the Draft Construction Waste Management Plan:
 - .1 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into CWM Plan.
 - .2 Waste-to-Energy Systems: Investigate local waste-to-energy incentives where systems for diverting materials from landfill for reuse or recycling are not available.
- .2 Certifications: Provide proof of the following during the course of the Work:
 - .1 Compliance Certification: Provide proof that recycling center is third party verified and is listed as a Certified Facility through the registration and certification requirements of the Recycling Certification Institute.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the Project waste and the available recycling and reuse programs in the Project area.
- .2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:
 - .1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
 - .2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.
- .3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

2 Execution

2.1 (CWM PLAN) IMPLEMENTATION

- .1 Manager: Contractor is responsible for designating an on site party or parties responsible for instructing workers and overseeing and documenting results of the CWM Plan for the Project.
- .2 Distribution: Distribute copies of the CWM Plan to the job site foreman, each Subcontractor, the Department Representative and other site personnel as required to maintain CWM Plan.
- .3 Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, composting and return methods being used for the Project to Subcontractor 's at appropriate stages of the Project.
- .4 Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:
 - .1 Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
 - .2 Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.
- .5 Progressive Documentation: Submit a monthly summary of waste generated by the Project to ensure that waste diversion goals are on track with Project requirements:
 - .1 Monthly waste summary shall contain the following information:
 - .1 The amount in tonnes or m³ and location of material landfilled,
 - .2 The amount in tonnes or m³ and location of materials diverted from landfill, and
 - .3 Indication of progress based on total waste generated by the Project with materials diverted from landfill as a percentage.

2.2 SUBCONTRACTOR'S RESPONSIBILITY

- .1 Subcontractor 's shall cooperate fully with the Contractor to implement the CWM Plan.
- .2 Failure to cooperate may result in the Department representative not achieving their environmental goals, and may result in penalties being assessed by the Contractor to the responsible Subcontractor 's.

2.3 SAMPLE CONSTRUCTION WASTE MANAGEMENT FORMS

- .1 Sample waste tracking form below can be used by the Contractor to establish their own forms for recording management of construction waste:

.1

Material Stream	Diverted Waste by Report Date	Total	Units				
Sept	Oct	Nov	Dec				
Material Streams Contributing to Credit	Plastic	1.25	2.5	10	5	18.75	m ³
Carpet	2.5	2.5	2.5	0	7.5	m ³	
Paper/Cardboard	5	2.5	2.5	5	15	m ³	
Clean Wood	0	25	0	1.25	26.25	m ³	
Metal	1.25	2.5	5.5	7	16.25	m ³	
Gypsum Board	2.5	2.5	4	5	14	m ³	
Brick/Concrete	10.5	2.5	5.5	8.75	27.25	m ³	
Asphalt Shingles	10	0	0	0	10	m ³	
Total Diverted Waste	135	m ³					

2.

Material Streams not Contributing to Credit	Landfill	10.75	7.5	15	10	43.25	m ³
Screen Fines (ADC)	5	1.25	0	2.5	8.75	m ³	
150 mm Minus (ADC)	1.25	1.25	5	5.5	13	m ³	
Total Landfill/ADC Waste	65	m ³					
Total Waste	200	m ³					
Percent Diverted	67.5	%					

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2- 2008, Stipulated Price Contract.
 - .2 DOC 14- 2000, Design-Build Stipulated Price Contract.
 - .3 DOC 15- 2000, Design-Builder/ Consultant Contract.
- .2 Canadian Environmental Protection Act (CEPA)
 - .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Department Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Department Representative's inspection.
 - .2 Department Representative's Inspection:
 - .1 Department Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in French that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, balanced and fully operational.
 - .4 Certificates required by Utility companies: submitted.
 - .5 Operation of systems: demonstrated to Department representative's personnel.
 - .6 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Department Representative, and Contractor.
 - .2 When Work incomplete according to Department Representative, complete outstanding items and request re-inspection.
 - .5 Declaration of Substantial Performance: when Department Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .6 Commencement of Lien and Warranty Periods: date of Department representative's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
 - .7 Final Payment:
 - .1 When Department Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

- .2 Refer to CCDC 2: when Work deemed incomplete by Department Representative, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.3 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

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

1.2 ADMINISTRATIVE REQUIREMENTS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: Vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: Provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

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

1.6 AS-BUILT DOCUMENTS AND SAMPLES

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

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of blue line opaque drawings, and in copy of Project Manual, provided by Department Representative.
- .2 Use felt tip marking pens, maintaining separate colors for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.

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

1.8 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 color 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 coordination drawings, with installed color 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 Additional requirements: As specified in individual specification Sections.

1.9 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: Include product data, with catalogue number, size, composition, and color 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.

1.10 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification Sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Department Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit before final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification Sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Department Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit before to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification Section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Department Representative.
 - .2 Include approved listings in Maintenance Manual.

1.11 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Department Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Department Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Department Representative for approval before each monthly pay estimate.

- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Department representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Department Representative.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.
 - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .3 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
 - .4 Procedure and status of tagging of equipment covered by extended warranties.
 - .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Department Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

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

END OF SECTION

1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Department representative's personnel two weeks before date of substantial performance.
- .2 Department representative: Provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure testing, adjusting, and balancing has been performed in accordance with Section and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
 - .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 before designated dates, for Department Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies 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 Department representative's personnel.
 - .2 Submit written report that demonstration and instructions have been completed.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 This section is limited to portions of the Building Management Manual (BMM) provided to Department Representative by Contractor.
- .2 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 HVAC - Heating, Ventilation and Air Conditioning.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.
 - .7 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS

- .1 Standard letter size paper 216 mm x 279 mm.
- .2 Methodology used to facilitate updating.
- .3 Drawings, diagrams and schematics to be professionally developed.
- .4 Electronic copy of data to be in a format accepted and approved by department representative.

1.3 APPROVALS

- .1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Department Representative.

1.4 GENERAL INFORMATION

- .1 Provide Department Representative the following for insertion into appropriate Part and Section of BMM:
 - .1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
 - .2 Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
 - .1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
 - .3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
 - .4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
 - .5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
 - .6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
 - .7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
 - .8 Operating and maintenance manual - Section 3.2 of BMM.
 - .9 Final commissioning plan as actually implemented.
 - .10 Completed commissioning checklists.
 - .11 Commissioning test procedures employed.

- .12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Department Representative.
- .13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

- .1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- .2 Department Representative to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
 - .1 Recommended maintenance procedures and schedule.
 - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

- .1 Provide Department Representative supporting documentation relating to installed equipment and system, including:
 - .1 General:
 - .1 Finalized commissioning plan.
 - .2 WHMIS information manual.
 - .3 Approved "as-built" drawings and specifications.
 - .4 Procedures used during commissioning.
 - .5 Cross-Reference to specification sections.
 - .2 Mechanical:
 - .1 Installation permits, inspection certificates.
 - .2 Piping pressure test certificates.
 - .3 Ducting leakage test reports.
 - .4 TAB and PV reports.
 - .5 Charts of valves and steam traps.
 - .6 Copies of posted instructions.
 - .3 Electrical:
 - .1 Installation permits, inspection certificates.
 - .2 TAB and PV reports.
 - .3 Electrical work log book.
 - .4 Charts and schedules.
 - .5 Locations of cables and components.
 - .6 Copies of posted instructions.
- .2 Assist Department Representative with preparation of BMM.

1.7 LANGUAGE

- .1 English and French Language to be in separate binders.

1.8 IDENTIFICATION OF FACILITY

- .1 When submitting information to Department Representative for incorporation into BMM, use following system for identification of documentation:

1.9 USE OF CURRENT TECHNOLOGY

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .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:
 - .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.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.02 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, Departmental 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 Valves schedule and flow diagram.
- .7 Color 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 2 copies of draft Operation and Maintenance Manual to Department Representative for approval. Submission of individual data will not be accepted unless directed by Department Representative.
 - .2 Make changes as required and re-submit as directed by Department 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 Department Representative will provide 1 set of reproducible mechanical drawings. 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 reproducible, revising reproducible to show work as actually installed.
 - .3 Use different color 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 Departmental 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.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One seal kit for each pump.
- .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.

1.04 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 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 in a manner to protect them from marks, scratches and scuffs.
 - .3 Replace damaged materials and equipment with new materials and equipment.
- .4 Develop Construction Waste Management Plan related to Work of this section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 EXECUTION

2.01 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 Department Representative
 - .2 Inform Departmental 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 Department Representative.

2.02 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

2.03 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

2.04 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.
- .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.

2.05 DEMONSTRATION

- .1 Department Representative will use equipment and systems for test purposes prior to acceptance. Supply labor, material, and instruments required for testing.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

2.06 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

2.07 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 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.

1.02 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.03 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 Department 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 the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.04 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 02 41 16 - Structure Demolition
- .3 Section 02 41 19.13 - Selective Building Demolition
- .4 Section 02 41 19.16 - Selective Interior Demolition
- .5 Section 02 41 00.08 - Demolition - Minor Works
- .6 Section 02 42 00 - Removal and Salvage of Construction Materials

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following 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

1.06 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Department Representative's continued occupancy requirements during selective demolition with Section 02 41 19.13 - Selective Building Demolition and schedule staged occupancy and worksite activities as a defined Critical Path in Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM)

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Federal Workers' Compensation Service, Provincial/Territorial Workers' Compensation Boards/Commissions
 - .2 Government of Canada, Labour Program: Workplace Safety, Provincial/Territorial Occupational Health and Safety Standards and Programs

1.08 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition time of site examination before tendering.
- .2 Existing Hazardous Substances: Department Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in the Hazardous Products Act.
 - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
 - .3 Hazardous substances will be removed by Department Representative under a separate contract or as a change to the Work.

1.09 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 Department Representative's property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials

2 PRODUCTS

2.01 MATERIALS

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.13 - Selective Building Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 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
- .3 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.

3 EXECUTION

3.01 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; Department 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.

3.02 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 Department 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 Department Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Department Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.03 EXECUTION

- .1 Demolition: Coordinate requirements of this Section with information contained in Section 02 41 19.13 - Selective Building Demolition Interior and as follows:
 - .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 the Department 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.

3.04 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 02 42 00 - Removal and Salvage of Construction Materials.

END OF SECTION

1 GENERAL

1.01 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.
 - .4 AWWA NSF 61 Annexe G (teneur en plomb de 0.25% maximum)

- .4 CSA Group (CSA)
 - .1 CSA-B64 Series-11, 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.

- .5 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.

- .6 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).

- .7 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201-R2010 Water Hammer Arresters Standard.

1.02 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 Department Representative in accordance with Section 01 31 19 - Project Meetings 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.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures. Indicate VOC's:
- .2 Shop Drawings:
 - .1 Shop drawings submitted must bear the seal and signature of a competent engineer recognized or licensed to practice in the province of Quebec.
 - .2 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Manufacturers' Field Reports: manufacturers' field reports specified.
- .6 Sustainable Design Submittals:
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .4 Regional Materials: submit evidence that project incorporates required regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.04 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.

1.05 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 as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal

2 PRODUCTS

2.01 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, polished nickel bronze or stainless steel square or round cover with flush head securing screws, beveled edge frame complete with anchoring lugs.
 - .2 Floor Access: rectangular or round cast iron body and frame with adjustable secured nickel bronze top or cast box with anchor lugs and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: cast iron or nickel bronze round or square, gasket, vandal-proof screws.
 - .3 Cover for Terrazzo Finish: polished nickel bronze or brass 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.
- .3 See plans for specifications

2.02 WATER HAMMER ARRESTORS

- .1 Stainless steel or Copper construction, bellows piston type: to PDI-WH201.

2.03 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principal type double check valve assembly back flow preventer with intermediate atmospheric vent or vacuum breaker.

2.04 VACUUM BREAKERS

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric hose connection

2.05 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

3 EXECUTION

3.01 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 Department Representative
 - .2 Inform Department 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 Department Representative

3.02 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.

3.03 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada (NPC) and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.04 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.05 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.06 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain or service sink.

3.07 BACKWATER VALVES

- .1 Install in main sewer lines where indicated and at weeping tile connection in pit provided at building cleanout.

3.08 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.09 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.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.10 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 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.

- .4 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .5 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .6 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .7 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.

3.11 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.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.13 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

1 GENERAL

1.01 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.
 - .7 ASME B36.19M-04, Stainless Steel Pipe.
- .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).
 - .11 ASTM F 876-15, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
 - .12 ASTM F 877-11, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .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.
 - .3 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
- .4 CSA Group (CSA)
 - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.

- .2 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 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly 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-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC) 2015
- .9 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).
- .10 ULC Standards:
 - .1 CAN/ULC-S101-07, Fire Resistance Tests for Buildings and Building Materials
 - .2 CAN/ULC-S102.2-10, Surface Burning Characteristics of Floorings and Miscellaneous Materials and Assemblies
 - .3 CAN/ULC-S115-11, Fire Resistance Tests for Firestop Systems

1.02 RELATED REQUIREMENTS

- .1 Section 23 05 23.01 - Valves - Bronze

1.03 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 insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 DOCUMENTS AND ELEMENTS TO BE SUBMITTED UPON COMPLETION OF WORK

- .1 Provide the required maintenance sheets and attach them to the manual mentioned in Section 01 78 00 - Documents/Elements to be submitted on completion of the work.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L: to ASTM B 88M.

2.02 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: 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 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22 cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.03 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.04 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

2.05 SWING VALVES

.1 Check valves with a nominal diameter equal to or less than DN 2, to be welded

.1 Check valves in accordance with standard MSS-SP-80, class 125, category 860 kPa, bronze body, flapper shutter, bronze, threaded and screwed bonnet, rectifiable seat, according to the prescriptions of section 23 05 23.01 - Valves - Bronze.

.2 Check valves with a nominal diameter equal to or less than DN 2, to be screwed

.1 Check valves in accordance with standard MSS-SP-80, class 125, category 860 kPa, bronze body, flapper shutter, bronze, threaded and screwed bonnet, rectifiable seat, according to the prescriptions of section 23 05 23.01 - Valves - Bronze.

2.06 BALL VALVES

.1 Ball valves, with a nominal diameter equal to or less than DN 2, to be screwed

.1 Class 150 valves.

.2 Bronze body, stainless steel ball valve, adjustable PTFE packing, brass packing gland, PTFE seat, steel lever, as specified in Section 23 05 23.01 - Valves - Bronze.

.2 Ball valves, with a nominal diameter equal to or less than DN 2, to be welded

.1 Valves to ANSI/ASME B16.18, Class 150

.2 Bronze body, stainless steel ball valve, adjustable PTFE packing, brass packing gland, PTFE seat, steel lever, with NPT/copper adapters, as specified in section 23 05 23.01 - Faucets - Bronze.

3 EXECUTION

3.01 PRESSURE TESTS

.1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.02 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.03 PRE-START-UP INSPECTIONS

- .1 Ensure that all elements of the network are in place before proceeding with flushing, testing and start-up.
- .2 Ensure system can be drained completely.

3.04 START-UP

- .1 Provide continuous supervision during start-up.
- .2 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Bring HWS storage tank up to design temperature slowly.
- .3 Rectify start-up deficiencies.

3.05 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.06 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal Requirements.

END OF SECTION

1 GENERAL

1.01 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.

- .3 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.

- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.

- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).

- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.02 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.

1.03 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 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary storm 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: tin- 95:5, type TA, to ASTM B 32.

2.02 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary storm and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.ASTM C564 or
 - .2 Stainless steel clamps.
 - .2 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Cold caulking compounds.
 - .2 Above ground sanitary storm and vent: to CAN/CSA-B70.
 - .1 Joints:
 - .1 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 EXECUTION

3.01 APPLICATION

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

3.02 INSTALLATION

- .1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.
- .2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.03 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.04 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal Requirements.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 National Air Duct Cleaners Association (NADCA)
 - .1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.
- .2 North American Insulation Manufacturers Association (NAIMA)
 - .1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.
- .3 United States Environmental Protection Agency (US EPA)
 - .1 US EPA 1999, 40 CFR Parts 152 and 156.

1.02 DEFINITIONS

- .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Return air plenums including ceiling plenums;
 - .5 Cooling and heating coils and compartments;
 - .6 Condensate drain pans, eliminator blades and humidifiers;
 - .7 Fans, fan blades and fan housing;
 - .8 Filter housing and frames;
 - .9 Acoustically insulated duct linings;
 - .10 Diffusers, registers and terminal units;
 - .11 Dampers and controls;

1.03 PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES

- .1 Engage and pay for services of independent testing laboratory in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Site Evaluation: conduct site visit 2 weeks before start of work to establish specific co-ordinated video survey and cleaning plan to establish specific co-ordinated video survey and cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.
 - .1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs, and other internal features.
 - .2 The plan should show the scheduling of inspection and cleaning activities for each HVAC system and the entire installation.

- .3 Departmental Representative to review video survey and cleaning plan 1 week minimum prior to start of work.
 - .1 Proceed with survey and cleaning work only after receiving written approval from Departmental Representative.
- .2 Scheduling: Hours of Operation: complete work during non-business hours as follows:
 - .1 Monday to Thursday between 18:00 hours and 07:00 hours.
 - .2 Friday from 18:00 h to Monday at 07:00 h.
 - .3 Work may not be carried out during statutory holidays.
 - .4 Hours of operation are subject to change with 12 hours notice.
- .3 Project Co-ordination: assign Project Co-ordinator to oversee air duct cleaning processes.
 - .1 Provide Department representative with contact information of Project Co-ordinator including: name, telephone number, cell phone number.
- .4 Security: Department Representative will pay costs and provide security escort at times requested on Contractor's submitted work schedule.
 - .1 Cancellation of security escort requires 72 hours minimum written notice.
 - .2 Failure to cancel security escort requirements 72 hours minimum before scheduled event will result in Contractor paying for security costs.
- .5 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by Department Representative.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit video survey and cleaning plan developed during site evaluation.
 - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.
 - .2 Provide two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements for antimicrobial agents or coatings.
- .4 Testing Laboratory Services: submit name and address of laboratory engaged for work of this Section.
 - .1 Submit laboratory analysis report of particulate collection indicating:
 - .1 Location of collection;
 - .2 Particulate grade;
 - .3 Particulate size;
 - .4 Percentage concentration of individual particulates in each sample.
- .5 US EPA Registration: submit verification of EPA Registration of antimicrobial agent.
- .6 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility, as described in PART 3 - CLEANING - Waste Management.

1.06 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems sketches identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Identification of points where samples were collected and type of analysis used for each collection;
 - .6 Identification of each sample collected;
 - .7 Comments complete with photographs of each sampling location and other observed system features;
 - .8 Identify systems tested, observations, actions taken and recommendations for future maintenance.
- .3 Record post cleaning video survey: submit 2 copies of video survey USB Drive media, and include on video survey following:
 - .1 Areas tested for particulate analysis or microbial growth evaluation;
 - .2 Areas of special interest and location;
 - .3 Special internal features;
 - .4 Problems such as broken or damaged controls or components;
 - .5 Ensure system tested, locations, observations, actions taken and recommendations are clearly identified in French on video using text or voice over.
- .4 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

1.07 EXTRA MATERIALS

- .1 Extra Stock Materials:
 - .1 Supply 4 extra filters for each HVAC System cleaned.
 - .2 Ensure filters are correct match, size, type and configuration of existing HVAC Systems.

2 PRODUCTS

2.01 ACCESS DOORS AND PANELS

- .1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.
 - .1 Size access doors and panels in equipment to allow for inspection and cleaning.

- .2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketed seal.
 - .1 Ensure access door is 25 mm greater in every dimension than access opening.
 - .2 Access door size 200mm x 200 mm minimum.
 - .3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
- .3 Access Doors and Panels Acoustic Lining:
 - .1 Install acoustic lining to match existing.
 - .2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.
 - .3 Water-based duct sealer for repairing cut acoustic lining.

2.02 ANTIMICROBIAL AGENT

- .1 Use antimicrobial agents registered with US EPA-40 CFR

2.03 SYSTEM FILTERS

- .1 Supply and install new filters for each HVAC System cleaned.

2.04 AIR DUCT CLEANING EQUIPMENT

- .1 Manually propelled full contact brushes:
 - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
 - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.
 - .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted motor drive and nylon polypropylene or other non-metallic material bristles.
 - .1 Ensure motor drive has capacity to continue to push brush after bristles are distorted.
 - .2 Replace worn and ineffective brushes when required.

3 EXECUTION

3.01 PREPARATION

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
 - .1 Control devices;
 - .2 Fire and smoke control dampers;
 - .3 Balancing dampers: indicate and record positions for resetting;
 - .4 Air volume control boxes: indicate and record positions for resetting;
 - .5 Fire alarm devices;

- .6 Monitoring devices and controls;
- .3 Cut openings in equipment panels and ductwork for access to system interior.
 - .1 Square or rectangular opening sizes: 200 mm minimum each side.
 - .2 Circular opening sizes: 200 mm minimum diameter.
- .4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.
 - .1 Install access doors and panels for inspection and cleaning of equipment as follows:
 - .1 Fan units;
 - .2 Filters;
 - .3 Dampers;
 - .4 Sensors;
- .5 Installation of Access Doors in Ductwork: install access doors in ductwork where instructed by Department Representative to facilitate system inspection and cleaning.
 - .1 Access door installation is not permitted in flexible ductwork.
 - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
- .6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
 - .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.
- .7 Remove and reinstall ceiling tiles to gain access to HVAC system as required.
 - .1 Replace ceiling tiles damaged or soiled by air duct cleaning procedures.

3.02 EXAMINATION / PRE-CLEANING INSPECTION

- .1 Verification of Conditions:
 - .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
 - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
- .2 Evaluation and Assessment:
 - .1 Identify location and type of internal components.
 - .2 Identify extent of potential problems.
 - .3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform Department Representative.
 - .1 Do not proceed further with inspection operations until written approval from Department Representative.

3.03 PARTICULATE COLLECTION

- .1 Before starting duct cleaning, identify locations for sample collection and collect particulate samples.

- .2 Take samples from interior surfaces of HVAC system using sterile wipes for submission to independent testing laboratory.
- .3 For each HVAC system collect 4 samples from each HVAC unit as follows:
 - .1 Sample 1: collect from inside ventilation unit downstream of air filters but before fan discharge;
 - .2 Sample 2: collect downstream of fan discharge and 1 metre maximum downstream in first horizontal branch;
 - .3 Sample 3: collect at junction of last horizontal branch and start of low-pressure duct;
 - .4 Sample 4: collect at junction each air terminal unit and supply duct.

3.04 LABORATORY ANALYSIS

- .1 Ensure independent testing laboratory has demonstrated experience in work associated with air duct cleaning.
- .2 Ensure Super Electron Microscope (SEM) is used for analyzing and determining components of particulate collection samples:
 - .1 Identify components by grade and size;
 - .2 Report findings including percentage concentration of components to Department Representative
- .3 Proceed with HVAC System Cleaning only after laboratory analysis test results have been received.
- .4 Ensure cleaning technicians have safety equipment appropriate for toxic or hazardous conditions identified by laboratory analysis before proceeding with cleaning operations.

3.05 DUCT CLEANING

- .1 Do duct cleaning in accordance with NADCAACR Standard
- .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
 - .1 Isolate zone of duct using closed-cell polyurethane foam before cleaning.
- .3 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .4 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .5 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
- .6 Clean diffusers, registers, louvers, and other terminal units.
- .7 Remove perforated supply diffusers from suspended tee-bar ceiling.
 - .1 Dismantle and clean perforated plates and supply diffuser duct collars.
 - .2 Re-assemble perforated plate diffusers and reconnect to HVAC system using supply diffuser duct collar after cleaning.

- .8 Advise Department Representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.
 - .1 Department Representative will pay for costs of deactivation of fire alarm and smoke detector system.

3.06 COMPONENTS AND EQUIPMENT CLEANING

- .1 Brush and vacuum coils, humidifiers, air handling unit enclosures, and heat exchanger surfaces to achieve required cleanliness.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Department Representative for cleaning.
 - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
 - .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Department Representative
 - .1 Fan blades;
 - .2 Dampers;
 - .3 Turning vanes;
 - .4 Controls;
 - .5 Sensor bulbs;
 - .6 Fire alarms;
 - .7 Smoke detectors;

3.07 ANTI MICROBIAL APPLICATION

- .1 Apply antimicrobial agents when fungal growth is suspected.
- .2 Apply antimicrobial agents after removal of surface deposits and debris.
 - .1 Verify air duct interiors are free from deposits and debris by visual inspection
 - .2 Report findings to Department Representative
 - .3 Proceed with application of antimicrobial agents after written approval from Department Representative.
- .3 Apply antimicrobial agents in accordance with manufacturer's written instructions and US EPA 40 CFR registration and listing
- .4 Manual spray antimicrobial agents directly onto interior surfaces of HVAC air duct system.
 - .1 Do not use fog mist for downstream surfaces.

3.08 FIELD QUALITY CONTROL/FINAL INSPECTIONS

- .1 Post Cleaning Inspection: carry out final inspection using robotic camera and other visual inspection methods after final cleaning has been completed.
 - .1 Carry out video survey as directed by Department Representative

- .2 Include in final survey areas inspected by the constructor.
- .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
- .4 Re-collect and analyse particulates collected at same locations where original samples were collected before cleaning.
- .5 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.09 SYSTEM STARTUP

- .1 Install new system filters after cleaning operations are completed.
- .2 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.
- .3 Restart each HVAC system.

3.10 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, 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.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Regional materials and equipment: provide proof that the project incorporates regional products and materials/equipment, and indicating their cost, the distance between the location of the project and the place of extraction or manufacture which is the farthest, as well as the total cost of the regional products/materials/equipment that will be incorporated into the project.

1.02 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, Departmental 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 Valves schedule and flow diagram.
 - .7 Color 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 2 copies of draft Operation and Maintenance Manual to Department Representative for approval. Submission of individual data will not be accepted unless directed by Department Representative.
 - .2 Make changes as required and re-submit as directed by Department 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 Departmental Representative will provide 1 set of reproducible mechanical drawings. 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 reproducible, revising reproducible to show work as actually installed.
 - .3 Use different color 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 Departmental 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.

1.03 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 head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .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.

1.04 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 Develop Construction Waste Management Plan related to Work of this.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

3 EXECUTION

3.01 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 Department Representative.
 - .2 Inform Department 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 Department Representative.

3.02 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.03 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.04 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.
- .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.

3.05 DEMONSTRATION

- .1 Department Representative will use equipment and systems for test purposes prior to acceptance. Supply labor, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
- .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 Departmental Representative will record these demonstrations on video tape for future reference.

3.06 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.07 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of heating, ventilation and air conditioning systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section ready for new construction.

1.02 REFERENCE STANDARDS

- .1 CSA Group (CSA):

1.03 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 Department 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 the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.04 RELATED REQUIREMENTS

- .1 Section 02 41 19.13 - Selective Building Demolition
- .2 Section 02 41 19.16 - Selective Interior Demolition
- .3 Section 02 42 00 - Removal and Salvage of Construction Materials

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following 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 and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Department representative's continued occupancy requirements during selective demolition with 02 41 19.16 - Selective Interior Demolition and schedule staged occupancy and worksite activities as a defined Critical Path in Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM)

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Federal Workers' Compensation Service, Provincial/Territorial Workers' Compensation Boards/Commissions
 - .2 Government of Canada, Labour Program: Workplace Safety, Provincial/Territorial Occupational Health and Safety Standards and Programs

1.08 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Department 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 Department representative under a separate contract or as a change to the Work.
 - .6 Proceed only after written instructions have been received from Department Representative.

1.09 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 Department representative.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.

2 PRODUCTS

2.01 MATERIALS

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.13 - Selective Building Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 HVAC 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.
- .3 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.

3 EXECUTION

3.01 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; Department 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.

3.02 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 Department 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 Department representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Department Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.03 EXECUTION

- .1 Demolition : Coordinate requirements of this Section with information contained in Section 02 41 19.13 - Selective Building Demolition and as follows:
 - .1 Disconnect and cap gas supply and electrical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active or energized utilities without approval of the Department 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.

3.04 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 reuse in new construction in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.

1.02 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .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 Material Safety Data Sheets (MSDS).
 - .2 NEMA MG 11-1977, Energy Management Guide for Selection and Use of Single-Phase Motors

1.03 RELATED REQUIREMENTS

- .1 Section 23 73 00.16 – Air treatment packaged units

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Submit a complete list of HVAC motors and identify their locations before beginning motor installation.
- .3 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
- .4 Upon request, submit documents signed by the manufacturer, certifying that the products, materials and equipment meet the requirements for physical characteristics and performance criteria.

1.05 DOCUMENTS/ITEMS TO BE SUBMITTED UPON COMPLETION OF WORK

- .1 Submit documents/elements required in accordance with Section 01 78 00 - Documents/Elements to be submitted on completion of work.
- .2 Submit maintenance records for motors, transmissions and guards, and attach to Operation and Maintenance Manual.
- .3 Submit field test reports.

1.06 MATERIALS/REPLACEMENT MATERIALS TO BE PROVIDED

- .1 Provide one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals, unless otherwise specified in other applicable section of Division 23.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.08 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 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 MOTORS

- .1 Provide specified motors for devices and mechanical systems covered in other sections.
- .2 Motors: high efficiency to ANSI/ASHRAE/IES 90.1.
- .3 Motor speed: variable
- .4 Motors less than 1/2 hp: unless otherwise indicated on drawings, motors to NEMA MG 11, single phase, 120V, speed as indicated, for continuous duty, with built-in overload protection and resilient mounting.
- .5 Motors 1/2 hp and larger: unless otherwise specified, motors housed, to ANSI/NEMA MG1 standards, three phase, 600V, squirrel cage induction, ball bearings, speed as indicated, for service continuous, at a temperature rise not exceeding 40°C.

- .6 Temporary motors: motors with adequate performance and approved by Department Representative for temporary use.

2.02 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 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 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 Correct size of sheave determined 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 Motor slide rail adjustment plates to allow for center line adjustment.

2.03 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centers for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

3 EXECUTION

3.01 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.02 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 - SUBMITTALS.

3.03 CLEANING

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 22 11 16 – Domestic water piping

1.02 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(R2006), 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(R2008), 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(R2007), 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.

1.03 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 Departmental 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.

1.04 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 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

3 EXECUTION

3.01 APPLICATION

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

3.02 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 15 applicable requirements of provincial authority having jurisdiction.

3.03 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.

3.04 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Department Representative.
- .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.

3.05 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 Department Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and spot 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 Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic particle tests.
- .5 Full radiographic tests for piping systems.
 - .1 Spot radiography:
 - .1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Department 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 Department 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.

3.06 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.07 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.08 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Seismic restraint systems for statically supported and vibration isolated equipment and systems; including laboratory fume hoods, BSC's, incinerators, kitchen equipment, electrical light fixtures, transformers, MCC's, UPS, diesel generators, standby power, fire protection, communications, equipment and systems, both vibration isolated and statically supported.

1.02 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).

1.03 DEFINITIONS

- .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.

1.04 DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.
 - .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Québec.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
- .3 Submit design data including:

- .1 Full details of design criteria.
 - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender bid documents), materials lists, schematics, full specifications for components of each SRS to be provided.
 - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .4 Separate shop drawings for each SRS and devices for each system, equipment.
 - .5 Identification of location of devices.
 - .6 Schedules of types of SRS equipment and devices.
 - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .8 Installation procedures and instructions.
 - .9 Design calculations including restraint loads to NBC and Supplement.
 - .10 Detailed work sheets, tables Simplified, Detailed work sheets, tables. Simplified, conservative assumptions may be acceptable.
 - .11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.
- .4 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Closeout Submittals:
- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.

1.06 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.07 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 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 SRS MANUFACTURER

- .1 SRS from one manufacturer regularly engaged in SRS production.

2.02 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.
- .7 Wet pipe sprinkler systems: refer to Section 21 13 13 - Wet Pipe Sprinkler Systems.
- .8 Seismic control measures not to interfere with integrity of firestopping.

2.03 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.04 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.
 - .2 SRS to resist complete isolator unloading.
 - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
 - .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
-
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

2.05 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

2.06 SERVICE UTILITIES ENTRANCE INTO BUILDING

- .1 Provide flexibility to prevent breakage in the event of earthquake activity.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Attachment points and fasteners:
 - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.

- .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
 - .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .3 Install SRS at least 25 mm from equipment, systems, services.
 - .4 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
 - .5 Co-ordinate connections with other disciplines.
 - .6 Vertical tanks:
 - .1 Anchor through house-keeping pad to structure.
 - .2 Provide steel bands above center of gravity.
 - .7 Horizontal tanks:
 - .1 Provide at least two straps with anchor bolts fastened to structure.

3.03 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 Departmental Representative within 3 days of manufacturer representative's review.
- .2 Inspection and Certification:
 - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
 - .2 Provide written report to Department Representative with certificate of compliance.
- .3 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Department Representative complete set of construction documents, revised to show "as-built" conditions.

3.04 CLEANING

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

END OF SECTION

1 GENERAL

1.01 SUMMARY

.1 Test, adjust and balance HVAC equipment to meet specified performance requirements.

1.02 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

1.03 RELATED REQUIREMENTS

- .1 Section 23 01 31 – HVAC Air Duct Cleaning
- .2 Section 23 73 00.16 – Air treatment monobloc appliances

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Testing, adjusting and balancing each separate system and each system in relation to related systems, in the case of slave systems.
- .2 Timetable:
 - .1 Allow time for work in this section (including repairs and re-testing) within the construction schedule to ensure that work is completed before the scheduled completion date.

1.05 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION

- .1 Submit the proposed methodology and procedures for carrying out the work in this section.
- .2 Before commencing work on this section, submit the names and documented qualifications of personnel to perform the work in this section.
- .3 Submit the list of instruments and include serial numbers and calibration certificates.
- .4 Preliminary Report: submit to the Department Representative for verification and approval prior to submission of the formal report. Include the following:
 - .1 details of the instruments used;
 - .2 details of the procedures used;
 - .3 the calculation methods used;
 - .4 recapitulations.

.5 Test and balancing report:

- .1 The report format should conform to the requirements of ANSI/AABC National Standards for Total System Balance and show results in SI units.
- .2 Include:
 - .1 drawings to be placed on the project file;
 - .2 the schematic diagrams of the systems concerned.
- .3 Submit six copies of the report to the departmental representative in both official languages, digital files.

1.06 QUALITY ASSURANCE

- .1 Regulatory requirements: testing and balancing systems regulated by codes to the satisfaction of the competent authority.
- .2 Agency Qualifications: Company specializing in testing, adjusting and balancing the systems listed in this section with at least three years of documented experience, certified by AABC.
- .3 When the device manufacturer's calibration recommendations are more stringent than those listed in the ERA standards, use the manufacturer's recommendations.

3 EXECUTION

3.01 PREPARATION

- .1 During construction, coordinate the location and installation of measuring and balancing devices, apparatus, accessories, measuring openings and fittings.
- .2 Calibrate instruments in accordance with the requirements of the most stringent standard or reference document for HVAC or other systems under work.
- .3 Calibrate instruments within three months of commencing work. Submit the calibration certificate.
- .4 Notify the Departmental Representative seven days prior to the commencement of work.

3.02 VERIFICATION OF CONDITIONS

- .1 Verify that the building is substantially completed, including:
 - .1 the completion of ceilings and the installation of doors, windows and other building elements that may affect the work have been completed;
 - .2 the installation of sealants, caulking and sealants has been completed;
 - .3 pressure, leak proofness and other tests prescribed in other sections of Division 23 are completed;
 - .4 the equipment necessary to perform the work is installed and in good working order;
- .2 Verify the appropriate, normal and safe operation of mechanical systems and related electrical and control systems affecting the work, including but not limited to:
 - .1 Thermal protection of electrical equipment against overloads, in place.
 - .2 Aeraulic networks
 - .1 Filters in place and clean.
 - .2 Clean air ducts.
 - .3 Airtight ducts, ducts and plenums within prescribed limits.

- .4 Fans rotating in the right direction.
- .5 Volumetric dampers and fire and smoke dampers in place and open.
- .6 Coil fins, clean and straightened.
- .7 Inspection doors and hatches installed and closed.
- .8 Outlet vents installed and volumetric dampers open.

3.03 GETTING THE SYSTEM UP AND RUNNING

- .1 Unless otherwise specified, follow the start-up procedure recommended by the manufacturer of the equipment and systems.
- .2 Follow any specific start-up procedures prescribed elsewhere in the equipment sections.

3.04 SETTING

- .1 Operating systems as required for the performance of the work and by the Department Representative for the verification of reports.
- .2 Test systems for safe and proper operation, to determine the actual point of operation, and to evaluate the qualitative and quantitative performance of equipment, systems and related control/control devices at a rating, medium or low load, whether actual or simulated.
- .3 Adjust devices and systems so that they meet prescribed performance requirements and can interact as prescribed with other related systems under normal and emergency load and operation.
- .4 Balance devices and systems so that the flow rate matches the load over the entire operating range.
- .5 Equipment noise: measure the noise emitted by the equipment.

3.05 AERAULIC SYSTEMS

- .1 Test and balance aeraulic systems in accordance with ANSI/AABC National Standards for Total System Balance.
- .2 take appropriate measurements depending on the application, in particular on the following: air velocity, static pressure, flow, pressure drop (or pressure drop), temperature (dry bulb, wet bulb, dew point), air duct cross-section, rotational speed, demand power, voltage, noise and vibration levels.
- .3 Document the location of equipment measurements in the report, including:
 - .1 at the inlet and outlet of dampers, filters, heating and cooling batteries, humidifiers, fans and any other apparatus causing changes in conditions;
 - .2 regulators and controlled devices and apparatus.
 - .3 main air ducts, main and secondary branch ducts and supply ducts for terminal elements (grilles, register grids or diffusers).
- .4 Smoke control systems: check the operation of fire and smoke dampers and flaps which are part of the ventilation systems prescribed in Division 23.

3.06 TOLERANCES

- .2 HVAC systems: +5%, -5% design.
- .4 Accuracy: +/-2 % of actual values.

3.07 ON-SITE QUALITY CONTROL

- .1 The results recorded may be verified by the Department Representative. Verify the number and location of results as directed by the Department Representative.
- .2 Provide personnel and instruments to verify not more than 30% of the recorded measurements.
- .3 Repeat work as required until results conform to prescribed performance values.

3.08 COMPLETION ACTIVITIES

- .1 Once the work is completed to the satisfaction of the Department Representative, replace the guards of the training or transmission devices, close the doors and inspection hatches, lock the devices in the defined position and verify that the sensors are set to the required set points.
- .2. mark the adjustment positions permanently; These must not be erased or covered in any way.

3.09 MAINTENANCE

- .1 Measure wet bulb temperature (or percentage relative humidity), noise levels, jet configuration, dry bulb temperature, air velocity, in the occupied area of office spaces.
- .2 Emergency evacuation: participate in comprehensive emergency evacuation drills.
- .3 Participate in the general verification of the systems twice during the warranty period, the first, approximately three (3) months after receipt of the work, and the second, during the last month of the warranty period.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Contents of the section: materials, equipment and methods for pressure testing of blowing, return or exhaust air ducts more than 10 m in length, directly or indirectly connected to air handling equipment.

1.02 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - .1 ANSI/SMACNA 016-2012, HVAC Air Duct Leakage Test Manual

1.03 RELATED REQUIREMENTS

- .2 Section 23 05 93 - Testing, Tuning and Balancing of HVAC Systems

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling of works:
 - .1 Test ductwork before insulation or other forms of cladding are installed.

1.05 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION

- .1 Submit the required documents and samples in accordance with Section 01 33 00 - Documents and samples to be submitted.
- .3 Submit details of the test instruments to be used at least three (3) months prior to the scheduled start date.
- .4 Certificates: submit instrument calibration certificates 28 days or less prior to the start of testing.
- .5 Test reports: submit test reports issued by recognized independent laboratories certifying that products, materials and equipment meet the requirements for physical characteristics and performance criteria. Data and results on pressure tests shall be submitted in accordance with the following requirements:
 - .1 Submit the proposed test report form and format for approval at least three (3) months prior to the scheduled date of the first round of testing. Do not begin testing until written authorization from the Departmental Representative.
 - .2 Prepare the report of the test results and submit it within 24 hours of the completion of the tests. The report must include the following:
 - .1 a diagram of the entire network;
 - .2 a diagram of the portion of the system being tested, showing the control locations;
 - .3 the static pressures required and obtained;
 - .4. the differential pressure measured by the diaphragm at the control locations;
 - .5. the actual and permissible leakage rate (L/s) at the control locations;
 - .6 authenticated certification of results;

- .3 Include test reports in the final test and balancing report specified in section 23 05 93 - Testing, Tuning and Balancing of HVAC Networks.
- .4 Submit manufacturer site reports to the departmental representative.

1.06 QUALITY ASSURANCE

- .1 Work under this section shall be performed by the same organization as work under section 23 05 93 - Hvac System Testing, Tuning and Balancing.
- .2 Health and safety: comply with the requirements of section 01 35 29.06 - Health and safety requirements.

2 PRODUCTS

2.01 TEST INSTRUMENTS

- .1 Test instruments shall include the following:
 - .1 a fan capable of providing the required static pressure;
 - .2 a section of duct with pressure taps mounted on a calibrated depressive device (diaphragm or orifice plate) and precisely positioned;
 - .3 a flow measuring instrument compatible with the depress genic organ;
 - .4. the calibration curves of the depress genic organs used;
 - .5 a flexible sleeve to be connected to the duct network under test;
 - .6 smoke bombs for visual inspections.
- .2 Accuracy of test instruments: plus, or minus 3% of flow rate and pressure.
- .3 Calibration: calibrate instruments at minimum intervals of six (6) months and submit calibration certificates.

3 EXECUTION

3.01 TOLERANCES

- .1 The following system leakage tolerances are expressed as a percentage of total network throughput. Prorate network leakage tolerances.
- .2 Leakage rate: leakage shall not exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: acceptable leakage rate of -2%.
 - .2 VAV boxes and ducts downstream thereof: acceptable leakage rate of 2 %.
 - .3 Large low-pressure duct systems up to 500 Pa: acceptable leakage rate of 2%.
- .3 The test results shall be evaluated in relation to the following two basic parameters, i.e. the effective surface of the duct and the pressure within it.

3.02 TESTING

- .1 Conduct tests under ambient temperature conditions not likely to impair the performance of seals and seals.
- .2 Test the flexible manifolds connected to the VAV boxes.
- .3 Test duct lengths according to the capacity of the test equipment.
- .4 Test fittings, secondary ducts and insertion clamps.
- .5 Repair leaks and repeat tests until specified pressures are reached.
- .6 Base partial network leak calculations on ANSI/SMACNA 016.
- .7 Seal leaks that can be heard or felt regardless of their contribution to the total leakage rate.
Conduct further tests after the seals have been cured.

3.03 ON-SITE QUALITY CONTROL

- .1 On-site services of the manufacturer:
 - .1 The manufacturer of HVAC equipment shall review the handling, installation, protection and cleaning of its product(s) and submit written reports in an acceptable format attesting to the compliance of the work with the prescribed requirements.
 - .2 Manufacturer's on-site services: the manufacturer must make recommendations on the use of the products and carry out periodic on-site inspection visits to verify that the installation of the products complies with his instructions.
 - .3 Schedule site visits to review work at prescribed stages.
 - .1 After delivery and storage of the products and after completion of the preparatory or other work on which the work referred to in this section depends, but before the installation work begins.
 - .2 Two (2) times during the work, i.e. at 50% and 90% of the completion of the work.
 - .3 Upon completion of the work, once the cleaning has been completed.
 - .4 Performance Monitoring: The Department Representative will attend the tests and review the results for reporting.

3.04 CLEANING

- .1 Comply with section 01 74 00 - Cleaning.
- .2 Upon completion, remove excess materials, waste, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

.1 The section includes the following:

- .1 Thermal insulation for ducts and duct accessories.

1.02 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IES 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 ASTM International (ASTM):
 - .1 ASTM C335/C335M-17, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - .2 ASTM C449-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - .3 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .4 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - .5 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
 - .6 ASTM C1423-21, Standard Guide for Selecting Jacketing Materials for Thermal Insulation
 - .7 ASTM C1729-21, Standard Specification for Aluminum Jacketing for Insulation
 - .8 ASTM C1767M-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 Test Method Surface Combustion Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC-S702.1-14, Building Mineral Fiber Thermal Insulation Standard, Part 1: Material Specifications

1.03 DEFINITIONS

- .1 For the purposes of this Section, the following definitions apply:
 - .1 "Concealed" elements: mechanical services and equipment located in suspended ceilings, and inaccessible construction voids and enclosed spaces.
 - .2 "Apparent" elements: "unconcealed" elements (as defined above).
 - .3 "Insulating systems" means insulating material, fasteners, liners and other accessories.
 - .4 "Sheathing": synonymous with insulation and insulation.

1.04 RELATED REQUIREMENTS

- . 1 Section 23 05 29 - Brackets and suspensions for piping and HVAC devices

1.05 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION

- .1 Submit the required documents and samples in accordance with Section Section 01 33 00 - Documents and samples to be submitted.
- .2 Data sheets:
 - .1 Submit data sheets and manufacturer's documentation regarding duct insulation, and include product characteristics, performance criteria, dimensions, purposes and limitations.
- .3 Shop drawings: submit drawings.
- .4 Samples:
 - .1 Upon request, submit for approval: a complete set of each type of insulation system, insulation, coating and adhesive proposed.
 - .2 Mount the sample on a 12 mm plywood panel.
 - .3 Place a typed label below the sample indicating the network/fluid being conveyed.
- .5 Manufacturers' instructions:
 - .1 Submit the manufacturer's recommendations concerning the grouting of heat-insulating elements, as well as any indications concerning handling, sequence of processing, cleaning methods.
- .6 Documents and samples to be submitted related to design requirements for sustainable development: as per section 01 35 21 - LEED requirements.

1.06 QUALITY ASSURANCE

- .1 Qualification of the workforce:
 - .1 Installer: must be specialized in the work covered by this section, have at least three (3) years of proven experience in performing work of the type and scope corresponding to the project described herein, and possess the qualifications required by being a member of TIAC.

1.07 TRANSPORTATION, STORAGE AND HANDLING

- .1 Transport, store and handle materials and materials in accordance with Section 01 61 00 - General Product Requirements.
- .2 Deliver materials and materials to the job site in their original packaging, which must bear a label indicating the name and address of the manufacturer and the marks of the ULC.
- .3 Store at temperatures and under conditions recommended by the manufacturer.
- .4 Packaging waste management: carry out in accordance with section 01 74 19 - Waste management and disposal.

2 PRODUCTS

2.01 SUSTAINABILITY FEATURES

- . 1 Adhesives and sealants: Maximum VOC limit of 250 80 30 g/L in accordance with SCAQMD Rule No. 1168 GS-36 and in accordance with Section 01 35 21 - LEED Requirements.
- . 2 Provide GreenSeal Eco-Logo certified products.

2.02 HEAT-INSULATING MATERIALS

- .1 Mineral fibers: fiberglass, mineral wool or slag wool.
- .2 Degree of fire resistance/smoke: in accordance with CAN/ULC-S102.
 - .1 Maximum flame spread index: 25.
 - .2 Maximum smoke power index: 50.
- .3 The coefficient of thermal conductivity ("k" coefficient) shall not exceed the prescribed values at an average temperature of 24 °C, according to tests conducted in accordance with ASTM C335/C335M.
- .4 Type C-1: rigid mineral fiber board conforming to CAN/ULC S702.1 ASTM C612, with no factory-installed vapor barrier jacket.
- .5 Type C-2: Mineral fiber mattresses conforming to CAN/ULC S702.1 ASTM C612, with no factory-installed vapor barrier casing.
 - .1 Maximum "k" coefficient: Conforms to ASTM C553.

2.03 SHIRTS

- .1 Canvas sheathing: cotton canvas with a surface mass of 220 g/m², plain armour, coated with heat-insulated glue and diluted flame retardant in accordance with ASTM C921.
- .2 Insulating glue: compatible with insulation system.
- .3 Aluminum sheathing: complies with ASTM C1729, with no waterproof membrane.
 - .1 Thickness: 0.50 mm sheets.
 - .2 Finish: smooth textured surface of embossed stucco.
 - .3 Retaining strips and mechanical seals: of stainless steel, 0.5 mm thick, 12 mm wide.
- .4 Stainless steel sheathing: type: 316,304, conforms to ASTM C1767M.

- .5 External surface treatment and emittance:
 - .1 Type I (bare surface)
 - .2 Type II (surface coated with pigmented paint)
 - .3 Type IV (surface coated with PVF film)
 - .4 Type V (surface coated with PVDF-based coating)
 - .5 Category 1 (alloy T-304/T-304L)
 - .6 Category 2 (alloy T-316/T-316L)
- .6 Vapor barrier:
 - .1 Class A (polyfilm, minimum thickness 3 mils)
 - .2 Class C (polykraft)
 - .3 Class E (without vapour barrier)
- .7 Thickness: 0.50 mm sheet.
- .8 Finish: smooth wavy relief stucco.
- .9 Jacket retaining strips and mechanical fittings: stainless steel 19 mm wide, 0.5 mm thick.
- .10 Sheathing elbows: factory-manufactured, of the same material as straight, binary, smooth-finished sheathing, class A C E.

2.04 ANCILLARY PRODUCTS

- .1 Vapor barrier overlap sealing glue: Water-based, flame retardant and heat-insulating compatible product.
- .2 Indoor vapor barrier coating: acrylic-type vinyl emulsion, compatible with insulation.
- .3 Insulating cement: hydraulically handled, on mineral wool, conforms to ASTM C449.
- .4 Exterior vapor barrier finishes:
 - .1 Acrylic-type vinyl emulsion, compatible with insulation.
 - .2 Uncoated glass fiber reinforcement cloth with a surface mass of 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, unreinforced, at least 50 mm wide.
- .6 Contact glue: quick-setting.
- .7 Canvas shirt glue: washable.
- .8 Fastening wire: made of stainless steel 1.5 mm diameter.
- .9 Retaining strips: of stainless steel, 0.5 mm thick, 12 mm wide.
- .10 Siding: galvanized stainless steel mesh with 25 mm hexagonal mesh, stapled on one side both sides of the insulation on one side of the insulation faces, the other side being covered with an expanded metal lath.
- .11 Fastening devices: dowels 4-2 mm in diameter and of a length suitable for the thickness of the insulation, and retaining pads of 35 mm side diameter.

3 EXECUTION

3.01 PREPARATION

- .1 Verify that duct system pressure testing is completed, attested and certified.
- .2 Check that surfaces are clean, dry and free of foreign matter.

3.02 INSTALLATION

- .1 Install in accordance with the manufacturer's instructions and the requirements of the MICA National Commercial and Industrial Insulation Standards Manual.
- .2 Install materials in accordance with manufacturer's instructions.
- .3 Use two (2) insulation thicknesses by shifting the joints when the required nominal thickness is greater than 75 mm.
- .4 Maintain uninterrupted continuity and integrity of the vapour barrier and finishes. Insulation must be continuous through openings in walls and ceilings, except when a firewall is required.
 - .1 Ensure that suspensions and brackets do not pierce the vapour barrier and comply with the requirements of Section 23 05 29 - Brackets and suspensions for pipes and HVAC devices.
- .5 Install a high compressive strength insulation when it is likely to be compressed by supports or suspensions due to the weight of the ducts.
- .6 Place the fasteners 300 mm centre apart vertically and horizontally at least two (2) rows on each wall.
- .7 To cold air ducts, fix with strips. Fasteners penetrating or piercing the underlying vapour barrier are not acceptable.

3.03 ON-SITE QUALITY CONTROL

- .1 Non-conforming work:
 - .1 Replace insulation with damaged or moisture-saturated vapor barriers.

3.04 TABLE - INSULATION FOR AIR DUCTS

.1 Types and thicknesses of insulation: Conform to the following table.

	Type	Vapour barrier	Thickness (mm)
Rectangular cold air and hot/cold air blowing ducts	C-1	Yes	50
Cylindrical cold air and hot/cold air blowing ducts	C-2	Yes	50
Air blowing, return and exhaust ducts, visible			N/A
Rectangular ducts, exteriors	C-1	special	50
Acoustically lined ducts	N/A		

.2 Cylindrical conduits, apparent, of 600 mm in diameter or more, and of lesser diameter where they are liable to be damaged.

.1 Use type C-1 insulation grooved to suit the diameter of the duct.

.3 Finishes for exposed insulation:

	Rectangular, MICA manual	Rounds, MICA manual
Concealed ducts, interiors	N/A	N/A
Exposed ducts, interior, located in mechanical installation rooms	FIU/1	CRD/2
Exposed ducts, interior, located elsewhere	CRF/2	CRD/3
Exterior ducts, located in weather-exposed locations	CRF/3	CRD/4
Exterior ducts, located elsewhere	CRF/4 FIU/5	CRD/5

3.05 CLEANING

.1 Carry out cleaning work in accordance with section 01 74 00 - Cleaning.

.2 Waste management: carry out in accordance with section 01 74 19 - Waste management and disposal.

END OF SECTION

1 GENERAL

1.01 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 of the Contract Documents.
- .2 Construction Team: Contractor is responsible for performing tests and verification activities specified in the relevant Sections of Division 23 of the Contract Documents and submitting reports to Department representative.
 - .1 Subcontractors: HVAC subcontractors participate in commissioning activities in coordination with field 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 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 Department Representative: The Department representative will designate a person to represent the interests of the facility related to work specified in relevant Sections of Division 23.
 - .1 O&M Representative: Department 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).

1.02 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, Building Commissioning
 - .2 CSA Z5000-18, Building Commissioning for Energy Using Systems

1.03 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 Cx 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 CxA Plan, as specified in Section 01 91 13 – General Commissioning Requirements

1.04 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

1.05 RELATED REQUIREMENTS

- .1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.06 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 Department representative with the following qualifications:
 - .1 Technical personnel with a minimum of five years' experience in construction, 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 Drainage requirements of HVAC equipment and connection of water make-up to HVAC systems specified in the relevant Sections of Division 22 of the Contract Documents.
 - .2 Metering equipment and control devices supplied as specified in the relevant Sections of Division 25 of the Contract Documents, but requiring to be installed on HVAC systems.
 - .3 Electrical distribution serving HVAC equipment, including disconnects and starters, as specified in the relevant Sections of Division 26 of the Contract Documents.
 - .4 Requirements for fire alarm shutdown relays on HVAC equipment and for smoke control systems operation as specified in the relevant Sections of Division 28 of the Contract Documents.
- .3 Notification: notify the Department representative and 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 Department Representative, 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 Department representative.

1.07 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 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: Department representative and the AHJ.
 - .2 Review the proposed schedule through the course of the work and notify the Department representative 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 Field 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 91 13 – General Commissioning Requirements

1.08 CLOSEOUT SUBMITTALS

- .1 Submit O&M data and as-built information in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Field 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.

2 PRODUCTS

2.01 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 of Division 23.

3 EXECUTION

3.01 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, dampers 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 HVAC 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, dampers, 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 and equipment 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 Field 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.

3.02 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 HVAC piping.
 - .2 Cleaning of HVAC ductwork.
 - .3 Contractor/manufacturer start-up of equipment.
 - .4 Electrical start-up of equipment including field electrical tests and verification of overloads and motor rotation.
 - .5 Confirm equipment electrical wiring diagrams are provided within the unit's electrical or controls enclosure.
 - .6 Start-up of chemical water treatment systems.
 - .7 Visual and mechanical inspections following equipment start-up.
 - .8 Verify proper staging control of multi-stage equipment and modulation of equipment supplied with variable control.
 - .9 Verify operation of safety controls and interlocks.
 - .10 Complete inspections required by authorities having jurisdiction.
 - .11 Setup and adjustment of system and expansion tank pressures on hydronic networks.
 - .12 Setup and adjustment of glycol feed systems.
 - .13 Verify temperature performance of hydronic and ventilation systems.
 - .14 Verify refrigerant charges.
- .2 Field Quality Control: Department representative and the AHJ will witness start-up activities for selected equipment. Notify the Department representative and the AHJ of start-up activities in accordance with Section 01 91 13 – General Commissioning Requirements.

3.03 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 the Department representative
- .2 Operate equipment as directed by Department representative 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.
- .4 Refer to Section 23 08 00 for commissioning requirements.
 - .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.

.5 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 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 cut-outs, 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 and optimize operation of systems involved in energy control strategies such as peak shaving and load shifting.
- .6 Verify that the proper schedules were configured for each HVAC equipment and system and confirm that they are disabled or set back when not required.
- .7 Confirm that airflow quantities in ventilation systems meet design and special requirements, specifically with regards to indoor air quality, building/space pressurization and energy optimization.
- .8 Verify TAB results in coordination with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- .9 Verify operation of HVAC equipment running on dual energy sources and optimize controls responsible for switching energy sources.
- .10 Confirm that simultaneous heating and cooling is not occurring at an equipment or system level.
- .11 Verify and optimize operating sequences, control parameters and setpoints for HVAC systems with an emphasis on energy management including the following:
 - .1 Ventilation and hydronic free cooling strategies.
 - .2 Setpoints for controlling pressures and temperatures in ventilation and hydronic systems.
 - .3 Operation of variable flow ventilation and hydronic systems.
 - .4 Setpoint optimization in ventilation systems:
 - .1 Supply/return air temperature reset strategies.
 - .2 Supply air static pressure reset strategies.
 - .5 Optimization strategies in hydronic systems:
 - .1 Loop temperature reset strategies in hydronic networks.
 - .2 Equipment staging conditions.
 - .3 Outdoor temperature reset strategies.

- .6 Occupied and unoccupied zone temperature setpoints.
- .7 Energy recovery system operation.
- .12 Verify and adjust system response to:
 - .1 Power failure.
 - .2 Loss of natural gas service.
 - .3 Poor outdoor air quality.
 - .4 Loss of domestic water supply.

3.04 CX OF INTEGRATED SYSTEMS

- .1 Refer to Section 01 91 26 - Integrated System Commissioning Requirements.
- .2 Operate equipment as directed by Department representative to perform commissioning of integrated systems.

3.05 SITE QUALITY CONTROL

- .1 Manufacturer's Field Services: obtain written certificates and reports from manufacturer verifying compliance of Work and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .1 Provide manufacturer's field services to complete start-up activities and assist in Functional Performance Testing as specified in the relevant Sections of Division 23.

3.06 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

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.02 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 electric and electronic control systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal

2 PRODUCTS**2.01 THERMOSTAT (LINE VOLTAGE-HEATING AND COOLING)**

- .1 See plans for specifications

2.02 THERMOSTAT (HEAVY-DUTY, LINE VOLTAGE, HEATING AND COOLING)

- .1 See plans for specifications

2.03 THERMOSTAT (LINE VOLTAGE, HEATING)

- .1 See plans for specifications

2.04 THERMOSTAT (LOW VOLTAGE)

- .1 See plans for specifications

2.05 THERMOSTAT (REMOTE BULB)

- .1 See plans for specifications

2.06 THERMOSTAT (FAN COIL)

- .1 See plans for specifications

2.07 THERMOSTAT GUARDS

- .1 Thermostat guards: lockable, clear opaque plastic I. Slots for air circulation to thermostat.

2.08 LOW LIMIT TEMPERATURE ALARM

- .1 Low limit temperature alarm with:
 - .1 Rating: 10.2 A at 120 V 6.5 A at 240 V.
 - .2 Sensing bulb and 1.5 6 m long capillary tube.
 - .3 Switching action: manual.
 - .4 Temperature setting range: 0 degrees C to 15 degrees C.

2.09 HIGH LIMIT TEMPERATURE ALARM

- .1 High limit temperature alarm with:
 - .1 Rating 10 A at 120 V 6 A at 240 V.
 - .2 Positive lock-out.
 - .3 Manual reset only after 14 degrees C drop-in temperature.
 - .4 Cutout setting: 50 degrees C.

2.10 SAIL SWITCH

- .1 Sail switch, mercury bulb type with stainless steel sail, adjustable range set m/s air velocity. Full load: A at 120 V. Maximum ambient temperature: 82 degrees C.

2.11 FLOW SWITCH

- .1 Flow switch in L/s water, pipe size as indicated, CSA Enclosure, rated at 16 A at 120 V. Maximum liquid temperature: 121 degrees C. Maximum liquid gauge pressure of 1034 kPa ambient temperature range 0 degrees C to 82 degrees C.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electric and electronic control systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Department 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 Department Representative.

3.02 INSTALLATION

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

3.03 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
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
 - .2 ASME B16.25-07, Buttwelding Ends.
 - .3 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
 - .6 ANSI B18.2.1-96(R2005), Square and Hex Bolts and Screws (Inch Series).
 - .7 ANSI/ASME B18.2.2-87(R2005), Square and Hex Nuts (Inch Series).
- .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 ASTM International (ASTM)
 - .1 ASTM A 47/A 47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A 126-04, Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- .4 CSA Group (CSA)
 - .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
 - .1 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71-2005, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.02 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 valves and pipes 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 Territory, Canada.

1.03 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
 - .1 Special servicing requirements.

1.04 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 21 - Waste Management and Disposal.

1.05 EXTRA MATERIALS

- .1 Extra Stock Materials:
 - .1 Provide spare parts as follows:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

2 PRODUCTS

2.01 PIPE

- .1 Steel pipe: to ASTM A 53/A 53M, Grade B, as follows:
 - .1 Steam and condensate

2.02 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.
- .4 Pipe thread: taper.
- .5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
- .6 Buttwelding ends: to ANSI/ASME B16.25.

2.03 FITTINGS

- .1 Pipe flanges: cast-iron to ASME B16.1, Class 125.
- .2 Screwed fittings: malleable iron to ASME B16.3, Class 150.

- .3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.
- .4 Buttwelding fittings: steel to ANSI/ASME B16.9.
- .5 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.

2.04 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2 1/2 and larger:
 - .1 Equipment: Flanged ends.
 - .2 Elsewhere: Flanged ends.
- .2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
- .3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: with composition disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 With composition lead-free bronze disc, cast iron with bronze trim, to Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: .
- .4 Gate valves: Application: pumped and gravity condensate return service, steam drip point assemblies.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, cast iron, lead-free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: .
 - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, cast iron with lead-free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

- .6 Bypass valves around large size gate and globe valves: as specified Section 23 05 23.03 - Valves - Cast Steel.
- .7 Lift check valves:
 - .1 NPS 2 and under: Class 125, lift, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over: as specified Section 23 05 23.02 - Valves - Cast Iron.

3 EXECUTION

3.01 APPLICATION

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

3.02 PIPING

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified below.
- .2 Connect branch lines into top of mains.
- .3 Install piping in direction of flow with slopes as follows, unless indicated:
 - .1 Steam: 1:240.
 - .2 Condensate return: 1:70.
- .4 Make provision for thermal expansion as indicated.
- .5 Drip pocket: line size.

3.03 VALVES

- .1 Install globe valves around, NPS 8 and over, gate valves.

3.04 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for HVAC.
- .2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.05 SYSTEM START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.06 PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 Verify performance in accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems supplemented as specified herein.

- .2 Timing, only after:
 - .1 Pressure tests successfully completed.
 - .2 Flushing as specified has been completed.
 - .3 Water treatment system has been commissioned.
- .3 PV Procedures:
 - .1 Verify complete drainage of condensate from steam coils.
 - .2 Verify proper operation of system components, including, but not limited to:
 - .1 Steam traps - verify no blow-by.
 - .2 Flash tanks.
 - .3 Thermostatic vents.
 - .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
 - .1 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .4 Humidifiers: for commissioning procedures, refer to Section 23 84 13 - Humidifiers.
- .5 Condensate pumping units: for commissioning procedures, refer to Section 01 91 13 - General Commissioning Requirements.

3.07 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 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 A307-12, 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 B52-05(R2009), B52 Package, 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.

1.02 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 Department Representative in accordance with Section 01 31 19 - Project Meetings 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.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures. Indicate VOC's for adhesive and solvents during application and curing.
 - .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.04 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 for incorporation into manual.
- .3 Submit 2 copies of operation and maintenance manual.

1.05 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 refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21 - LEED Requirements.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal

2 PRODUCTS

2.01 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.

2.02 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees 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.

2.03 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.04 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

3 EXECUTION

3.01 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 Department Representative
 - .2 Inform Department 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 Department Representative

3.02 MANUFACTURER'S INSTRUCTIONS

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

3.03 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

3.04 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.

3.05 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.

3.06 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.

3.07 FIELD QUALITY CONTROL

- 1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
 - .2 Ambient temperatures to be at least 13 degrees 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 Department 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 Department Representative
 - .9 Manufacturer's Field 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 field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

- .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, 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 Department Representative.

3.08 DEMONSTRATION

- .1 Instructions:
 - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

3.09 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 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 LEAK DETECTIONS

- .1 Complete the preventive and corrective maintenance form for any new refrigeration or air conditioning system, as per the Federal Halocarbon regulations (2003)

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
 - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-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 A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC, Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (Reference Kit) (including 2007 Addendum).
 - .2 LEED Canada-CI, Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for the Interior Design of Commercial Spaces.
 - .3 LEED Canada 2009 Design and Build-2010, LEED (Leadership in Energy and Environmental Design): Green Building Rating System.
 - .4 LEED Canada-Existing Buildings, Operations and Maintenance 2009, LEED Canada 2009 (Leadership in Energy and Environmental Design): Rating System for Existing Green Buildings: Operations and Maintenance.
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .5 National Fire Protection Agency 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.
- .6 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.
- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.02 RELATED REQUIREMENTS

- .2 07 84 00 - Fire protection
- .3 07 92 00 - Sealants for seals
- .4 23 05 29 - Brackets and suspensions for piping and HVAC appliances
- .5 23 05 94 - Pressure testing of aeraulic systems

1.03 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION

- .1 Submit the required documents and samples in accordance with Section 01 33 00 - Documents/Samples to be submitted.
- .2 Data sheets
 - .1 Submit the required data sheets and manufacturer's instructions and documentation for metal air ducts. Data sheets should indicate product characteristics, performance criteria, dimensions, limits and finish.
- .3 Shop drawings
 - .1 Submitted shop drawings must bear the seal and signature of a competent engineer recognized or authorized to practice in Quebec, Canada.
- .4 Test Reports and Evaluation Reports
 - .1 Reliability of technical data
 - .1 Data from manufacturers' catalogues and documentation shall be reliable data, confirmed by tests carried out by the manufacturers themselves or, on their behalf, by independent laboratories, and certifying compliance with the requirements of applicable codes and standards.
- .5 Sustainable Design Documents/Samples to Submit
 - .4 Regional Materials and Equipment: Provide evidence that the project incorporates the required percentage of 50% regional products and materials/equipment, including their cost, the distance between the project site and the furthest extraction or manufacturing site, and the total cost of regional products/materials/equipment to be incorporated into the project.

1.04 TRANSPORTATION, STORAGE AND HANDLING

- .1 Transport, store and handle materials and materials in accordance with Section 01 61 00 - General Product Requirements and the manufacturer's written instructions.
- .2 Delivery and Acceptance: deliver materials and materials to the job site in their original packaging, which must bear a label indicating the name and address of the manufacturer.
- .3 Storage and Handling
 - .1 Store materials and equipment so that they do not rest on the floor indoors dry, in a clean, dry and well-ventilated place, in accordance with the manufacturer's recommendations.
 - .2 Store metal air ducts in such a way as to protect them from marks, scratches and scratches.
 - .3 Replace damaged materials and equipment with new materials and equipment.

2 PRODUCTS

2.01 AIRTIGHTNESS CLASSES

.1 The airtightness class of ducts shall be determined according to the data in the table below.

Maximum pressure Pa	Sealing class (SMACNA)
500	C
250	C
125	C

.2 Leakage classes

- .1 Class A: longitudinal joints, cross joints, wall bushings and connections sealed with a product and sealing tape.
- .2 Class B: longitudinal joints, transverse joints and connections sealed with a sealant of a sealing tape or a combination thereof.
- .3 Class C: transverse joints and connections sealed with gaskets. Unsealed longitudinal joints.

2.02 SEALANT

.1 Characteristics related to sustainable development

- .1 Adhesives and sealants: in accordance with section 07 92 00 - Sealants for seals.
- .2 Adhesives and sealants: maximum VOC content of 70 g/L, according to SCAQMD Regulation No. 1168.

.2 Sealant: for air ducts, polymer-based, flame retardant, oil-resistant and able to withstand temperatures ranging from -30 degrees Celsius to 93 degrees Celsius.

2.03 SEALING TAPE

.1 Sealing tape: glass fiber membrane, loosely armored, polyvinyl treated, 50 mm wide.

2.04 AIR-DUCT TIGHTNESS

.1 As required in the SMACNA HVAC Air Duct Leakage Test Manual.

2.05 FITTINGS

.1 Manufacturing: according to SMACNA.

.2 Round-angled elbows

- .1 Rectangular ducts: standard radius elbows, with single-layer deflectors; radius of curvature corresponding to 1.5 x the width of the duct.
- .2 Circular conduits: large radius elbows five (5) pieces; radius of curvature corresponding to 1.5 x the diameter of the duct.

.3 Sharp-angled elbows - rectangular ducts

- .1 Conduits of diameter equal to or less than 407 mm: elbows with double-thickness single deflectors.
- .2 Conduits with a diameter greater than 407 mm: elbows with double-thickness deflectors.

.4 Bypass fittings

- .1 Rectangular main and bypass ducts: arched branch on bypass, with radius of curvature corresponding to 1.5 x the width of the inlet duct at 45 degrees on the bypass.
- .2 Circular main and bypass ducts: 45-degree main duct inlet with transition connection.
- .3 Volumetric registers shall be placed in the branch ducts near the connections to the main duct.
- .4 The main diversions shall be equipped with a steering blade.

.5 Transition elements

- .1 Divergent elements: opening angle of not more than 20 degrees.
- .2 Converging elements: opening angle of not more than 30 degrees.

.6 Elements of diversion

- .1 Rounded elbows with large radius with small radius as indicated.

.7 Obstacle deflectors: to keep the same useful section.

- .1 The maximum opening angles shall be the same as in the case of transition elements.

2.06 FIREWALL PROTECTION

- .1 Retaining angles shall be installed around the ducts on each side of the fire bulkheads in accordance with section 07 84 00 - Fire protection.
- .2 Coordinate the requirements with those of section 07 84 00 - Fire protection to prevent ducts from being deformed by fire resistant materials and their placement.

2.07 GALVANIZED STEEL AIR DUCTS

- .1 Foldable steel ducts for forming staples: according to ASTM A653/A653M, with Z90 galvanization.
- .2 Thickness, manufacture and reinforcement: according to SMACNA.
- .3 Seals: SMACNA compliant registered trademark prefabricated gaskets for air ducts. Prefabricated, trademarked flanged gaskets for air ducts should be considered a Class A type of seal.

2.08 ALUMINUM AIR DUCTS

- .1 Aluminum: Type 3003-H-14, according to ASHRAE and SMACNA.
- .2 Thickness, manufacture and reinforcement: according to ASHRAE SMACNA indications.
- .3 Seals: according to ASHRAE SMACNA, welded continuously.

2.09 BRACKETS AND SUSPENSIONS

- .1 Brackets and suspensions: in accordance with Section 23 05 29 - Brackets and suspensions for pipes and HVAC devices.
 - .1 Suspension straps: of the same material as that used for the duct, but of a thickness immediately greater than that of the duct.
 - .1 Maximum size of ducts supported by straps: 500 mm.
 - .2 Form of suspensions: according to ASHRAE and SMACNA.
 - .3 Hanging angles and rods: black steel galvanized steel angles held by black steel galvanized steel rods, according to ASHRAE and SMACNA as shown in the following table.

Diam. Ducts (mm)	Diam. Angles (mm)	Diam. Stems (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
from 1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
from 2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Suspension attachment devices
 - .1 For fastening in concrete structures: prefabricated concrete anchors.
 - .2 For fixing to steel beams: prefabricated stirrups steel support pads.
 - .3 For fixing to steel beams: prefabricated stirrups.

3 EXECUTION

3.01 INSPECTION

- .1 Verification of conditions: Before proceeding with the installation of metal air ducts, ensure that the condition of the surfaces/supports previously implemented under other sections or contracts is acceptable and allows the work to be carried out in accordance with the manufacturer's written instructions.
 - .1 Conduct a visual inspection of surfaces/supports in the presence of the Department Representative.
 - .2 Immediately inform the Department Representative of any unacceptable conditions identified.
 - .3 Begin installation work only after correcting unacceptable conditions and receiving written approval from the Department Representative.

3.02 GENERAL

- .1 Perform the Work in accordance with the requirements of the relevant ASHRAE standards and the relevant NAATS standards.
- .2 Avoid interrupting the continuity of the vapor barrier membrane of the insulation by installing the straps or suspension rods.
 - .1 Extend the insulation of the insulated ducts on the suspension straps to a height of 100 mm Ensure that the diffusers are in place.
- .3 Secure vertical ducts in accordance with the requirements of the relevant ASHRAE standards and relevant NAATS standards.
- .4 Provide weakened joints on each side of the fire partitions.
- .5 Install trademarked, prefabricated flanged gaskets according to the manufacturer's instructions.
- .6 Manufacture ducts of lengths and diameters to facilitate the installation of the acoustic lining.

3.03 SUSPENSIONS

- .1 Install suspension straps in accordance with NAATS requirements.
- .2 Equip the hanging angles with locking nuts and washers.
- .3 Space suspensions according to the requirements of the ASHRAE of SMACNA below.

Diam. ducts	Spacing
(mm)	(mm)
up to 1500	3000
1501 and over	2500

3.04 WATERTIGHT DUCTS

- .1 The following ducts shall be watertight.
 - .2 Fresh air intakes.
 - .3 The ducts upstream and downstream of duct-mounted humidifiers over a distance of at least 3000 mm.
 - .4 All ducts indicated.
- .2 Shape the bottom of horizontal ducts without making longitudinal joints.
 - .1 Weld the transverse joints of the bottom and side plates.
 - .2 Seal all other joints with an air duct sealant.
- .4 Place a 150 mm deep drip basin with a 32 mm diameter drain pipe connected to a deep water guard siphon fitted with a tap and connected to a funnel drain at the bottom of the main ducts.

3.05 SCHEMMENT

- .1 Apply sealant according to SMACNA requirements and manufacturer's recommendations.
- .2 Drown the tape in the sealant, then cover with at least one (1) layer of the same product, as recommended by the manufacturer.

3.06 LEAK TESTS OF AIR DUCTS

- .1 See section 23 05 94 - Pressure testing of aeraulic systems.
- .2 Perform leak testing in accordance with the requirements set out in the SMACNA HVAC Duct Leakage Test Manual.
- .3 Conduct tests on a sectional basis.
- .4 Perform preliminary leakage tests (to detect air leaks) according to the instructions, to verify the quality of workmanship.
- .5 Do not lay further ducts until the results of these preliminary tests are satisfactory.
- .6 The sections tested shall be at least 30 m in length and have at least three (3) leads and two (2) bends at 90 degrees.
- .7 Do not insulate or conceal ducts until the required tests have been completed.

3.07 CLEANING

- .1 Cleaning during work: carry out cleaning work in accordance with section 01 74 00 - Cleaning.
 - .1 Leave the premises clean at the end of each working day.
- .2 Final Cleaning: Remove surplus materials/materials, waste, tools and equipment from the job site in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.03 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 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21 - LEED Requirements.

- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.02 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.03 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fiber insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.04 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.05 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.06 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.

3 EXECUTION

3.01 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 Department Representative.
 - .2 Inform Department 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 Department Representative.

3.02 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.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .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 and Viewing Panels:
 - .1 Size:
 - .1 300 mm x 300 mm for person size entry.
 - .2 300 mm x 300 mm for servicing entry.
 - .3 150 mm x 150 mm for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.

- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Department Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.03 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 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75 % of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Construction IAQ Management Plan:
 - .1 Submit Indoor Air Quality (IAQ) Plan for construction and pre-occupancy phases of building.
 - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings Under Construction.

1.03 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.

1.04 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 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 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal

2 PRODUCTS

2.01 GENERAL

- .1 Manufacture to SMACNA standards.

2.02 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.03 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 100 mm as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.04 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: as indicated.
- .4 Bearings: pin in bronze bushings
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

3 EXECUTION

3.01 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 Department Representative.
 - .2 Inform Department 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 Department Representative.

3.02 INSTALLATION

- .1 Install where indicated.
- .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 Department Representative.

3.03 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 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.

1.02 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.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Construction IAQ Management Plan:
 - .1 Submit Indoor Air Quality (IAQ) Plan for construction and pre-occupancy phases of building.
 - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings Under Construction.

1.03 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.

1.04 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 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 MULTI-LEAF DAMPERS

- .1 Opposed and or parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, 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 Damper actuator: Section 25 30 02 – EMCS: Field Control Devices.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow across damper.
- .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.

2.02 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 0.001% across damper.

2.03 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted spring assisted or counterweighted, as indicated.

2.04 RELIEF DAMPERS

- .1 Automatic multi-leaf aluminum dampers with ball bearing center pivoted and counter-weights set to open as indicated.

3 EXECUTION

3.01 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 Department Representative.
 - .2 Inform Department 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 Department Representative.

3.02 INSTALLATION

- .1 Install where indicated.
- .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.

3.03 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.02 RELATED REQUIREMENTS

- .2 Section 07 84 00 - Fire Protection
- .3 Section 23 33 00 - Accessories for air ducts

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate the installation of fire protection with Section 07 84 00 - Fire Protection.

1.04 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 fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.05 CLOSEOUT SUBMITTALS

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

1.06 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide:
 - .1 6 fusible links of each type.

1.07 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 fire and smoke dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.08 WARRANTY

- .1 Manufacturer's Warranty: Minimum one (1) year against defects in materials and workmanship.

2 PRODUCTS

2.01 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A BC, listed and bear label of ULC or UL Warnock Hersey, meet requirements of provincial fire authority, Fire Commissioner of Canada (FCC), CFFM and NFPA 90A authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.02 FIRE STOP FLAPS

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C or as indicated.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Department Representative.
 - .2 Inform Department Representative of unacceptable conditions immediately upon discovery.

3.02 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of fire stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

- .7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 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 Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.02 RELATED REQUIREMENTS

- .1 Section 07 84 00 – Fire Protection
- .2 Section 23 05 48 - Anti-vibration and seismic measures for HVAC installations

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate the installation of smoke and fire arrests around ducts that pass through fire separations with the work of Section 07 84 00 – Fire Protection.
 - .2 Coordinate the installation of pipes with anti-vibration connections with the work of Section 23 05 48 - Anti-vibration and seismic measures for HVAC installations.

1.04 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 flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Test and Evaluation Reports:
 - .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.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.05 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 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 flexible ducts from nicks, scratches, and blemishes.

2 PRODUCT

2.01 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

2.02 REGULATORY REQUIREMENTS

- .1 Flame spread index: Shall not exceed 25.
- .2 Fume emission index: Shall not exceed 50.
- .3 Insulation and coatings: Conform to ASTM C411, and without flame, glow, shouldering fire or smoke when exposed to maximum operating temperature.

2.03 METALLIC - UNINSULATED

- .1 Type 1: spiral wound flexible aluminum, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.04 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fiber thermal insulation with vapor barrier and vinyl reinforced mylar/neoprene laminate aluminum jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.05 ACCESSORIES

- .1 Closure systems: Conform to UL 181, non-metallic fasteners:
 - .1 Tape: Conforms to CAN/ULC-S109, pressure type

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Department Representative.
 - .2 Inform Department Representative of unacceptable conditions immediately upon discovery.

3.02 INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL 181, NFPA 90A, NFPA 90B and SMACNA.
- .2 Provide hermetic connections throughout the ducts.

3.03 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C 423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C 916-85(2007), Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C 1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C 1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G 21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 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 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-2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2007.
- .5 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct liners and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

- .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
- .4 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
- .5 Construction IAQ Management Plan:
 - .1 Submit Indoor Air Quality (IAQ) Plan for construction and pre-occupancy phases of building.
 - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings Under Construction.

1.03 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.

1.04 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 duct liners from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop a construction waste management plan for the work covered by this section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 DUCT LINER

- .1 General:
 - .1 Mineral Fiber 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 and NFPA 90A / NFPA 90B.

- .3 Recycled Content: EcoLogo certified with minimum 35% by weight recycled content.
- .4 Fungi resistance: to ASTM C 1338 ASTM G 21.
- .2 Rigid:
 - .1 Use on flat surfaces where indicated.
 - .2 25 mm thick, to ASTM C 1071 Type 2, fibrous glass rigid board duct liner.
 - .3 Density: 48 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.76 (m². degrees C)/W for 25 mm thickness 1.15 (m². degrees C)/W for 38 mm thickness 1.53 (m². degrees C)/W for 50 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on faced air side: 20.3 m/s.
 - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C 423.
 - .7 Recycled Content: EcoLogo certified containing minimum 45% by weight recycled content.

Acceptable product: Manson Akousti-Liner R. or approved equivalent

- .3 Flexible:
 - .1 Use on round or oval surfaces indicated.
 - .2 25 mm thick, to ASTM C 1071 Type 1, fibrous glass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.37 (m². degrees C)/W for 12 mm thickness 0.74 (m². degrees C)/W for 25 mm thickness 1.11 (m². degrees C)/W for 38 mm thickness 1.41 (m². degrees C)/W to 50 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on coated air side: 25.4 30.5 m/s.
 - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C 423.

Acceptable product: Manson Akousti-Liner R. or approved equivalent

2.02 ADHESIVE

- .1 Adhesive: to NFPA 90A and 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.

Accepted products: Duro Dyne WSA

2.03 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Nylon retaining clips, 32 mm square.

Accepted products: Duro Dyne CPT

2.04 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

Accepted products: Duro Dyne FTZ

2.05 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.

Accepted products: Duro Dyne DWN

3 EXECUTION

3.01 EXAMINATION

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

3.02 GENERAL

- .1 Except as otherwise indicated, perform work in accordance with SMACNA recommendations in "HVAC Duct Construction Standards, Metal and Flexible".
- .2 At the following places, fill the interior of the ducts with an acoustic liner
 - .1 On indicated on plans
 - .2 In air transfer
 - .3 At the exit of any ventilation units
 - .4 At the exit of VAV boxes
- .3 The dimensions shown on the drawings are in fact the internal dimensions of the duct, once the lining has been put in place.

- .4 Fabricate ducts in lengths that facilitate the installation of the liner.
- .5 Install insulation 10 feet apart and other fans and 5 feet downstream of end boxes.
- .6 Supply and return ducts for HVAC units shall have 25 mm (1 in.) of insulation over a length of 20 feet.

3.03 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 90 100% 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 centers 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 NAIMA AH116.
- .2 In systems, where air velocities exceed 20.3 m/s, install galvanized sheet metal nosing to leading edges of duct liner.

3.04 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 Department Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.05 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 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
 - .2 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18, Primer, Zinc Rich, Organic.

1.02 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 HVAC fans 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 Québec, Canada.
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, bhp kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

- .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.04 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 HVAC fans 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 35 21 - LEED Requirements.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.02 FANS GENERAL

- .1 See plans for specifications

2.03 CENTRIFUGAL FANS

- .1 See plans for specifications.

2.04 CABINET FANS - GENERAL PURPOSE

- .1 See plans for specifications.

2.05 IN-LINE CENTRIFUGAL FANS

- .1 See plans for specifications.

2.06 PROPELLER FANS

- .1 See plans for specifications.

3 EXECUTION

3.01 EXAMINATION

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

3.02 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.03 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.04 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
 - .1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Québec, Canada.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .3 Samples:
 - .1 Submit duplicate samples.
 - .
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Test data: to ANSI/AMCA Standard 210.
 - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
 - .2 Sound power level with minimum inlet pressure of 0.25 0.5 1 1.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

- .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .6 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
- .7 Sustainable Design Documents/Samples
 - .1 Construction waste management
 - .1 Submit the construction waste management plan waste reduction plan for the project, which must specify recycling and recovery requirements.
 - .2 Submit calculations for end-of-project recycling rates, recovery rates and landfill delivery rates, which must demonstrate that 50% of construction waste has actually been diverted from landfills.
 - .2 Recycled content (recycled content)
 - .1 Provide a list of products containing recycled materials that will be used, with details of the required percentage of recycled content. The list should indicate the cost of these products and their percentage of post-consumer and pre-consumer recycled content (post-industrial materials), as well as the total cost of products and materials/materials with recycled content that will be incorporated into the project.
 - .3 Regional Materials and Equipment: Provide evidence that the project incorporates regional products and materials/equipment, indicating their cost, the distance between the project site and the most remote extraction or manufacturing site, and the total cost of regional products/materials/materials that will be incorporated into the project.

1.03 CLOSEOUT SUBMITTALS

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

1.04 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 terminal units from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 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 certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.02 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.03 ELECTRONIC VARIABLE AIR VOLUME BOXES

- .1 Pressure independent, reset to air flow between zero and maximum air volume.
- .2 At inlet velocity of 10 m/s, differential static pressure for unit with attenuator section not to exceed 25 Pa.
- .3 Sound ratings of assembly not to exceed 25 NC.
- .4 Air velocity sensor resistance wire or pitot rack as standard to manufacturer.
- .5 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator digital as indicated. Shielded or twisted wire requirements is not acceptable.
- .6 Electronic thermostat furnished by terminal unit manufacturer and have set points and velocity adjustments located in thermostat. Heating and cooling set point range 13 to 30 degrees C. Set points not overlapping.
- .7 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Meter taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
- .8 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .9 Terminal unit to be CSA certified.
- .10 Casing: galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to UL

181 and NFPA 90A. Mount control components inside protective metal shroud.

- .11 Damper: steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .12 Sizes and capacity: as indicated.
- .13 See plans for specifications

3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

3.03 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, 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.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.02 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.

1.03 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 diffuser, registers and grilles from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 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.

2.02 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 and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Color: standard as directed by Department Representative

2.03 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.04 SUPPLY GRILLES AND REGISTERS

- .1 See plans for specifications

2.05 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 See plans for specifications

2.06 DIFFUSERS

- .1 See plans for specifications

2.07 LINEAR GRILLES

- .1 See plans for specifications

2.08 RESIDENTIAL GRILLES, REGISTERS AND DIFFUSERS

- .1 See plans for specifications

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Department Representative
 - .2 Inform Department 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 Department Representative.

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with oval head stainless steel screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

3.03 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 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI):
 - .1 ANSI/AHRI 430-2020, Standard for Performance Rating of Central Station Air-Handling Unit Supply Fans
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES):
 - .1 ANSI/ASHRAE 52.2-16, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
 - .2 ANSI/ASHRAE/IES 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings
- .3 ASTM International (ASTM):
 - .1 ASTM E2886/E2886M-20, Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement
- .4 Green Seal (GS):
 - .1 GS-11-21, Standard for Paints and Coatings
 - .2 GS-36-13, Standard for Adhesives for Commercial Use
- .5 Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual, current edition
 - .1 MPI #1.
- .6 South Coast Air Quality Management District (SCAQMD):
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings
 - .2 SCAQMD Rule 1168-2017, Adhesives and Sealants

1.02 RELATED REQUIREMENTS

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- .2 Section 23 33 00 - Air Duct Accessories
- .3 Section 23 33 15 - Dampers - Operating
- .4 Section 23 84 13 - Humidifiers

1.03 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 insulation, filters, adhesives, and paints 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 Quebec, Canada.
- .2 Indicate the following on the drawings: fan characteristic curves showing operating point motor drive bearings filters mixing boxes dampers flow control devices hot and cold coils; they must also indicate the performance characteristics of these elements.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.
- .3 Provide the necessary data on the following: fans bearings motors dampers air flow adjustment devices volumetric control devices total cooling capacity sensible cooling capacity inlet temperature, dry bulb temperature at the inlet, at the wet bulb the outside temperature (fresh air).

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 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 immediately prior to acceptance by Department Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air handling equipment from dust.

2 PRODUCTS

2.01 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/AHRI 430 with AHRI seal.
- .3 horizontal device type, as indicated, consisting of hermetic modular elements, comprising a casing, a fan unit with motor and drive, a filtration battery, dampers, a heating battery, a cooling battery, a humidifier, a mixing box, mixing box, mixing and filtration box, spillway.
- .4 Air Handling Units: ENERGY STAR certified.

2.02 CASINGS

- .1 Galvanized reinforced and braced for rigidity.
 - .1 Access door provide access for maintenance of internal parts.
 - .2 Paint steel parts, where not galvanized, with corrosion resistant paint to MPI #18.
 - .1 Paint: maximum VOC limit 250 g/L to GS-11 to SCAQMD Rule 1113.
 - .3 Finish units, inside and out, with rust resistant enamel
 - .1 Enamel Finish: maximum VOC limit 250 g/L to Standard GS-11 to SCAQMD Rule 1113.

2.03 ACOUSTIC LINER

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Insulate internal surface of panels with 50 mm neoprene coated rigid duct liner of 72 kg/m³ density.
 - .1 Apply with 100% coverage of adhesive with clip pins.
 - .2 Cover with 0.8 mm thick perforated galvanized sheet metal.
 - .3 Cover leading and trailing edges with sheet metal nosing and at edges around access doors and panels complete with 15 mm overlap.

2.04 DRAIN PANS

- .1 Construction: plastic, rounded corners.
- .2 Insulation: external foam type, minimum 13 mm thick.
- .3 Drain connection: in bottom at low point.
- .4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

2.05 FANS

- .1 Cabinet hung centrifugal fans with forward curved wheels, selected to operate in stable part of performance curve at times and 100,000 hours service self aligning bearings.
 - .1 Provide internally mounted motor as indicated complete with adjustable V-belt drive and guard.
 - .2 Motor: r/min.
 - .1 Motor Speed: variable.
 - .2 Maximum sound power levels, as indicated.
 - .3 Internally mounted motor and fan.

2.06 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan: to Section 23 33 00 - Air Duct Accessories.
- .2 Vibration isolators on fan section: in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.07 VARIABLE VOLUME DEVICES

- .1 Adjustable inlet vanes operated from centre mechanism linked to each damper vane or cantilevered vane mechanism.
 - .1 Support vanes in self lubricated bronze bearings.
 - .2 On DWDI fans interconnect vanes to operate simultaneously.
 - .3 Provide locking devices for manual operation.
- .2 Variable fan width sleeve mechanism with control linkage.
 - .1 For DWDI fans, provide interconnected linkage to operate simultaneously.
 - .2 Provide locking devices for manual operation.
- .3 Variable speed drives: frequency coverter
- .4 In the case of single width single inlet (SLSO) fans, spherical shutters controlled by an actuator which will move them from the back to the front so as to completely close the circuit inlet.

2.08 FILTER BOX

- .1 Material to match casing. For V type filter arrangement:
 - .1 Provide access to filter through hinged door with suitable hardware.
- .2 Provide blank-off plates and gaskets to prevent air bypass.
- .3 Filters: in accordance with Section 23 40 00 - HVAC Air Cleaning Devices.
 - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media, to be used on return air section of air handling unit.
 - .2 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ANSI/ASHRAE 52.2

2.09 MIXING BOX

- .1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 degrees C of design across face of outlet.
- .2 Dampers for mixing boxes: Section 23 33 15 - Dampers - Operating.

2.10 BLENDER STATIC AIR MIXING DEVICE

- .1 General:
 - .1 Pre-engineered device with no moving parts, designed to thoroughly mix warm and cold air streams, to within 3 degrees C pressure drop and to provide for even velocity distribution profile.
- .2 Sizing criteria:
 - .1 UTA-1.
 - .2 Type: Rooftop air conditioning unit
 - .3 Size: max 96"x 60". Should fit on existing base or with transition base.
 - .4 Pressure drop: 450 Pa.
 - .5 Capacity:
 - .1 Outside air: 800 PCM.
 - .2 Return air: 4000 PCM
 - .6 Mixed air temperature: 6 Summer Mixed Air Temperature: 80°F
 - .7 Supply temperature in summer: 56°F
 - .8 Mixed air temperature in winter: 50°F
 - .9 Supply temperature in winter: 75°F
 - .10 Type of cooling: DX air conditioning
 - .11 Type of heating: Electric coil
 - .12 Electric heating capacity: 27 kW
- .3 Construction:
 - .1 1.6 mm thick steel with corrosion resistant paint.
- .4 Blender section:
 - .1 Blender in housing ready for insertion into air handling unit.
 - .2 1.2 mm thick steel having 50 mm flanges on inlet and outlet, finished with corrosion resistant paint
 - .3 Complete with 25 mm, 32 kg/m³ density, fibreglass lining and insulated access door.
- .5 Blender mixing box:
 - .1 General: single unit consisting of dampers, blender, mixing section, with provision for floor mounting.
 - .2 Construction: steel, with duct connection flanges, reinforced for rigidity, finished with corrosion resistant paint.
 - .1 Paint: maximum VOC limit 250 g/L.

- .3 Dampers: parallel blade, low leakage, proportioning type.
 - .1 Leakage: not more than 50 L/s.m² at 750 Pa.
 - .2 Seals: neoprene on damper edges, top, bottom, sides of framing.
- .4 Blades of 1.6 mm thick steel, 150 mm maximum wide, locked to steel rods in rustproof bushings.

2.11 COILS

- .1 Capacity: as indicated.
- .2 Ratings: AHRI certified.
- .3 Construction:
 - .1 Casings: 1.5 mm thick galvanized sheet steel.
 - .1 Supports of galvanized steel.
 - .2 Blank-off plates. Insulated sandwich construction.
 - .2 Direct expansion refrigerant coils:
 - .1 Serpentine type arranged to prevent trapping of oil.
 - .1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits.
 - .2 Silver solder or braze joints in refrigerant tubing.
 - .3 Evacuate and charge coil with nitrogen and seal before sending to site.
 - .2 Tubes: copper.
 - .3 Fins: copper or aluminum.
 - .4 Headers: copper.
 - .5 Pressure tests: to Canadian Refrigeration Code. Dehydrated. Sealed with nitrogen charge.
 - .3 Refrigerant: R-410A.

2.12 HUMIDIFIERS

- .1 External, in accordance with Section 23 84 13 - Humidifiers.

3 EXECUTION

3.01 PERFORMANCE VERIFICATIONS

- .1 Refer to Section 23 05 93 for commissioning requirements.

3.02 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance

with manufacturer's written instructions.

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

3.03 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

3.04 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.05 DRIP PANS

- .1 Install deep seal P-traps on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.06 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: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
 - .1 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
 - .2 ANSI/ASHRAE 127-2007, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International (ASTM)
 - .1 ASTM C 547-11, Specification for Mineral Fiber Pipe Insulation.
- .3 CSA Group (CSA)
 - .1 CSA B52-05(R2009), Mechanical Refrigeration Code.
 - .2 CAN/CSA-C656-05(R2010), Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
 - .2 Indicate on drawings:
 - .1 Major components and accessories including sound power levels of units.
 - .2 Type of refrigerant used.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.03 CLOSEOUT SUBMITTALS

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

1.04 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 conditioning components 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 35 21 - LEED Requirements.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

1.05 WARRANTY

- .1 For computer room air conditioning 12 months warranty period is extended to 60 months.

2 PRODUCTS

2.01 DESCRIPTION

- .1 See plans for specifications.

2.02 REFRIGERANT CHARGE

- .1 Charge refrigerant system at factory, seal and test.
- .2 Holding charge of refrigerant applied at factory.

3 EXECUTION

3.01 EXAMINATION

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

3.02 GENERAL

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.03 EQUIPMENT PREPARATION

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.04 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 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.05 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 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 humidifiers 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 Quebec, Canada.
 - .2 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
 - .1 Indicate following:
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.
- .7 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.02 CLOSEOUT SUBMITTALS

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

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.
- .3 Provide following: one complete set of renewable evaporator media.

1.04 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 humidifiers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal and Section 01 35 21 - LEED Requirements.

2 PRODUCTS

2.01 DIRECT STEAM INJECTION TYPE

- .1 See plans for specifications

3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat as indicated in accessible location.
- .4 Water service overflow drain: as indicated to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .7 Install capped drain connection at low point in duct.

3.03 FIELD QUALITY CONTROL

- .1 Manufacturer's Field 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 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, 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 Department Representative.
- .2 Performance Verification (PV):
 - .1 General: in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
 - .2 Gas fired steam generator.
- .3 Start-up:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapor lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapor.
 - .2 Freedom from water deposits.

- .4 Commissioning Reports:
 - .1 General: 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.

3.04 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 13- General Commissioning Requirements: Training of O&M Personnel.

3.05 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 21 - Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 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.

1.02 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.

1.03 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01330 - Submittal Procedures.

- .2 Final Report: submit report to Department 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 Department 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 Department 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.

1.05 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Department Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.06 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of Department Representative and in presence of department representative.
- .3 Inform, and obtain approval from, Department Representative in writing at least 14 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 Department 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.

1.07 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Department Representative.

1.08 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.

2 PRODUCTS

2.01 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.

3 EXECUTION

3.01 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Department Representative.
- .3 Commission integrated systems using procedures prescribed by Department Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.02 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by Department 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 transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 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 meter 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 Departmental 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 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
 - .12 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 Departmental Representative Department 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 Department Representative and provide:
 - .1 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 Department 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 Department 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 30day 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 30 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 Commissioning Manager Department Representative to verify reported results.

3.03 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Department Representative, set and lock devices in final position and permanently mark settings.

3.04 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager Department Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.02 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.03 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 Departmental Representative 30 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.

1.04 QUALITY ASSURANCE

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Department Representative reserves right to approve instructors.

1.05 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.06 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).

1.07 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).

1.08 TRAINING PROGRAM

- .1 The program duration is to be determined with the department representative (maximum of 3 days) and is to begin after the system is approved for equipment maintenance personnel and programmers.
 - .1 The training is to be split amongst multiple instructors following a pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers training on the operations and functional procedures necessary to operate the system.
 - .2 Equipment maintenance training: provide training regarding the general disposition of the material, troubleshooting and preventative maintenance of EMCS equipment, maintenance and calibration of sensors and controls.

1.09 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

1.02 REFERENCE STANDARDS

- .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 Grey Color for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.03 ABBREVIATIONS AND ACRONYMS

- .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 Centre.

- .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.

1.04 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 shortforms 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 shortform 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.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.05 SYSTEM DESCRIPTION

- .1 Refer to control schematics on plans for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
 - .4 Data communications equipment necessary to effect 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 Department Representative prior to installation.
 - .3 Location of controllers as reviewed by Department Representative prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
- .1 Provide English or French operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and or French.
 - .4 System manager software: include in English and or French 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 and French:
 - .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-defilements).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers at time of bid tender within 48 hours within 10 days after award of contract.
 - .2 List existing field control devices to be re-used included in bid tender, along with unit price.
- .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: Shop Drawings, Product Data 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 Department 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 Department Representative.
- .8 Existing devices intended for re-use: submit test report.

1.07 QUALITY ASSURANCE

- .1 Have 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 submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 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 occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.08 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Department Representative with schedule within 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 21 - 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 in accordance with Waste Management Plan.
 - .4 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.
 - .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 as approved by Department Representative.
- .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.09 EXISTING- CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Department Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Department Representative.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Department Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Department Representative.
 - .1 Be responsible for items repaired or replaced by Department Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Department Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

2 PRODUCTS

2.01 CONTROL SYSTEM

- .1 Existing building controls are Delta controls.
- .2 All new controls will need to connect, integrate and communicate seamlessly with existing controls and connect to the existing enteliweb platform.
- 3. All graphs will need to be updated as the work changes.

2.02 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 and ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.03 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

3 EXECUTION

3.01 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.02 PAINTING

- .1 Painting: in accordance with Section 09 91 23- Interior 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

1 GENERAL

1.01 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).

1.02 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.03 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.

1.04 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 5 working days after tender closing and before contract award, for review by Department Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in Autocad - latest version and WordPerfect latest version Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.05 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include 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, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .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 center, field controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
 - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
 - .10 Compressor schematic and sizing data.

1.06 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) 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 Pneumatic schematics and schedules.
 - .5 Complete Point Name Lists.

- .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- .7 Software and programming details associated with each point.
- .8 Manufacturer's recommended installation instructions and procedures.
- .9 Input and output signal levels or pressures were new system ties into existing control equipment.
- .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 and water 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.

1.07 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 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 Department Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Department Representative.

END OF SECTION

1 GENERAL

1.01 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.

1.02 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.

1.03 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 Operation and Maintenance Manual to Department Representative in English and French.
- .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.

1.04 AS-BUILTS

- .1 Provide 1 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, wiring and control air lines 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 Department Representative.

- .3 Provide before acceptance 4Hard and 1 soft copy incorporating changes made during final review.

1.05 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 2complete 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 and existing 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.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colors and lettering sizes.

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.03 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.04 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English and French.

1.05 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 to Department Representative for approval samples of nameplates, identification tags and list of proposed wording.

2 PRODUCTS

2.01 NAMEPLATES FOR PANELS

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.02 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.

- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.03 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Department Representative.
- .3 Letter size: to suit, clearly legible.

2.04 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange colored signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Department Representative's.

2.05 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Color coding: to CSA C22.1. Use color coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.06 PNEUMATIC TUBING

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.07 CONDUIT

- .1 Color code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm color with Department Representative during "Preliminary Design Review".

3 EXECUTION

3.01 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.02 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
 - .2 ANSI C2-1990, National Electrical Safety Code.
 - .3 ANSI/NFPA 70-1990, National Electrical Code.
- .2 CSA Group
 - .1 CSA C22.1-12,
 - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems.
 - .3 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.
 - .4 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
 - .6 CAN/CSA-C22.3 No. 1-10, Overhead Systems.

1.02 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring from existing emergency 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 center BECC.
 - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .5 Refer to wiring diagrams included as part of flow diagrams in Section. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by engineer before commencing work.
- .2 Mechanical:
 - .1 Pipe Taps Required for EMCS equipment will be supplied and installed by Division 23 EMCS Contractor.
 - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23 EMCS Contractor.
 - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23 EMCS Contractor. Costs to be carried by designated trade.
- .3 VAV Terminal Units.
 - .1 Air flow probe for vav boxes to be supplied and installed under Section 23 36 00 - Air Terminal Units. Air flow dp sensor, actuator and associated vav controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.

- .4 Structural:
 - .1 Special steelwork as required for installation of work.

1.03 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

1.04 EXISTING CONDITIONS

- .1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Department Representative existing materials removed from work not identified for re-use.

2 PRODUCTS

2.01 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

2.02 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. Color code to CSA 22.1.
- .3 For wiring under 70 volts 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 centers, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: #18 AWG 20 AWG stranded twisted pair.
 - .4 Analog input and output: shielded #18 minimum solid copper #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.

2.03 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.

2.04 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.

2.05 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 as indicated.
 - .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 as indicated.
- .4 Finish for starters:
 - .1 Exterior: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Interior: white.

2.06 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.

3 EXECUTION

3.01 INSTALLATION

- .1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

3.02 PIPING

- .1 See plans for specifications

3.03 SUPPORTS

- .1 Install special supports as required and as indicated.

3.04 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 ANSI/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 CAN/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.

3.05 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 Department Representative before starting such work. Provide complete conduit system to link field panels and devices with main control center. 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 Department 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 Department 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 bonding conductor for 120 volt and above in conduit.

3.06 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 Departmental 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.

3.07 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.

3.08 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.

3.09 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 days written notice of intention to test.
 - .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
 - .4 Conceal work only after tests satisfactorily completed.
 - .5 Report results of tests to Departmental 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 Department Representative and authority having jurisdiction.

3.11 IDENTIFICATION

- .1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

1 GENERAL

1.01 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 References.
 - .1 Canada Labor 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.

1.02 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.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Department Representative.
- .3 Submit detailed inspection reports to Department Representative.
- .4 Submit dated, maintenance task lists to Department 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.
 - .8 .
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .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 Department Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Department Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

2 EXECUTION

2.01 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 Department 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 Labor 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 Operations Supervisor Department 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

1 GENERAL

1.01 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).

1.02 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2003, 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 (PSPC)/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>

1.03 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.04 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 Departmental 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 another 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).
- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
 - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
 - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.05 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 8bit 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 5amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees 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 and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Departmental 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.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .1 Submit product data sheets for each product item proposed for this project.

1.07 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

2 PRODUCTS

2.01 MASTER CONTROL UNIT (MCU)

- .1 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.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must support Proprietary Protocol BACnet.
- .3 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.
- .4 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.
 - .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.
- .5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Department Representative.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
 - .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English and French.

- .4 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify setpoints.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify setpoint weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.
 - .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to another controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.02 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 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.

2.03 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.
- .3 VAV Terminal Controller.
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
 - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
 - .3 Controller to operate independent of network in case of communication failure.
 - .4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.04 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 color, 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.

2.05 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PSPC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

3 EXECUTION

3.01 LOCATION

- .1 Location of Controllers to be approved by Department Representative.

3.02 INSTALLATION

- .1 Install Controllers in secure locking enclosures as indicated or as directed by Department Representative.
- .2 Provide necessary power from local 120V branch circuit panel for equipment.

- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and coordinating mode.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 01 73 00 - Execution Requirements.
 - .2 Section 07 84 00 - Firestopping.
 - .3 Section 23 09 43 - Pneumatic Control System for HVAC.
 - .4 Section 23 33 15 - Dampers - Operating.
 - .5 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .6 Section 25 05 01 - EMCS: General Requirements.
 - .7 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .8 Section 25 05 54 - EMCS: Identification.
 - .9 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .10 Section 26 05 00 - Common Work Results for Electrical.
 - .11 Section 26 27 10 - Modular Wiring System.
 - .12 Section 26 27 26 - Wiring Devices.

1.02 REFERENCE STANDARDS

- .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 B 148-97(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.

1.03 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.04 ACTION AND INFORMATIONAL 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 Department 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.

1.05 EXISTING CONDITIONS

- .1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Department Representative existing materials removed from Work not identified for re-use.

2 PRODUCTS

2.01 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 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 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.

- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.02 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 0degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3integral anchored lead wires. 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.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 mm as indicated.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .6 Stability 0.02 degrees C drift per year.
 - .7 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.
 - .2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460mm or as indicated.
 - .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.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.03 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: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.04 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.
 - .2 Operating temperature range: 0 - 60 degrees C.
 - .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 3%.
 - .2 Room sensors: plus or minus 2%.
 - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
 - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
 - .6 Room sensors: locate in air stream near RA grille wall mounted as indicated.
 - .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
 - .1 Range: 0 - 100 % RH minimum.
 - .2 Operating temperature range: -40 - 50 degrees C.
 - .3 Absolute accuracy: plus or minus 2%.
 - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
 - .5 Must be unaffected by condensation or 100% saturation.
 - .6 No routine maintenance or calibration is required.

2.05 HUMIDITY TRANSMITTERS

.1 Requirements:

- .1 Input signal: from RH sensor.
- .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
- .3 Input and output short circuit and open circuit protection.
- .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
- .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
- .6 Integral zero and span adjustment.
- .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
- .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.06 PRESSURE TRANSDUCERS

.1 Requirements:

- .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1% of Full Scale.

2.07 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.08 STATIC PRESSURE SENSORS

.1 Requirements:

- .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
- .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.09 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.5 % of output.
- .5 Linearity: within 1.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 VELOCITY PRESSURE SENSORS

- .1 Requirements:
- .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
- .2 Maximum pressure loss: 37Pa at 1000 m/s.
- .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

- .1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.1 % of output.
- .5 Linearity: within 0.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.12 LIQUID AND STEAM FLOW METERS

- .1 Features
 - .1 Nominal pressure: according to I/O summary report
 - .2 Nominal temperature: based on I/O summary report.
 - .3 Precision of the order of +/- 0.2%.
 - .4 Accuracy and linearity of the order of +/- 1.0%.
 - .5 Theoretical margin of adjustment of at least 10:1.
- .6 Tips
 - .1 Screw tips for flowmeters with a diameter of DN 2 or less.
 - .2 Flanged tips for flowmeters with a diameter equal to or greater than DN 2 1/2.

2.13 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Characteristics
 - .1 Internal parts suitable for continuous contact with compressed air, water, steam or air of quality suitable for the supply of measuring instruments, as appropriate.
 - .2 Adjustable set point and differential.
 - .3 Sudden break contacts at a nominal voltage of 120 V, 15 A AC or 24 V DC.
 - .4 Contacts with automatic intervention when the set point is exceeded, and with automatic reset when normal operating conditions are restored. Inlet protection against overpressure up to at least twice the nominal inlet pressure.
 - .5 Accuracy of the order of 2% in the case of recurrent switching.
 - .6 Isolation valve and shock absorber placed between the measured pressure source and the pressure switch, where the code permits.
 - .7 Pigtail siphon protection for high temperature steam and hot water pressure switches.

2.14 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1degrees C.
 - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with without protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.15 CURRENT / PNEUMATIC (I/P) TRANSDUCERS

- .1 Requirements:
 - .1 Input range: 4 to 20 mA.
 - .2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.
 - .3 Housing: dustproof or panel mounted.
 - .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
 - .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 2.0 % of full scale/ 50degrees C or less.
 - .8 Regulated supply pressure: 206 kPa maximum.

- .9 Air consumption: 16.5 ml/s maximum.
- .10 Integral gauge manifold c/w gauge (0-206 kPa).

2.16 SOLENOID CONTROL AIR VALVES

- .1 Solenoids suitable for 120 V AC or 24 V DC, as indicated.
- .2 Flow capacity of at least 0.15 L/s of air at a differential pressure of 140 kPa.

2.17 AIR PRESSURE GAUGES

- .1 Manometers at least 38 mm in diameter.
- .2 Measuring range of the order of 0 to two times the effective pressure of the fluid under consideration or the standard pressure closest to it.

2.18 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

2.19 SOLID STATE RELAYS

- .1 General
 - .1 Mounting on socket or rail.
 - .2 LED indicator light
 - .3 Input/output connection strips suitable for cables of size 14 to 18 AWG.
 - .4 Operating temperature range -20 to 70 °C.
 - .5 Certification CSA
 - .6 Input/output isolation voltage of 4000 V AC at 25 °C, for a period of not more than one (1) second.
 - .7 Service frequency range 45 to 65 Hz.

.2 Entry

- .1 Control voltage from 3 to 32 V DC
- .2 Release voltage of 1.2 V DC
- .3 Maximum input current suitable for analog output terminal.

.3 Output

- .1 Model for AC or DC current as required.

2.20 CURRENT TRANSDUCERS

- .1 Requirements:
- .2 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.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.21 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.

2.22 ADJUSTMENT REGISTERS

- .1 Modular construction registers not more than 1219 mm wide x 1219 mm high; with flaps not more than 152 mm wide x 1219 mm long; intermediate shafts in the case of registers with three or more sections.
- .2 Component elements
 - .1 Extruded aluminum frame, not less than 2.03 mm thick, insulated if the damper (intake or air extraction damper) is mounted outside.
 - .2 Extruded aluminum flaps, with insulated internal vacuum if the damper (intake or air extraction) is mounted externally.
 - .3 Self-lubricating bearings, made of synthetic material.
 - .4 Linkage and control shafts of aluminate, galvanized or nickel-plated steel.
 - .5 Seals of synthetic material, nested on the ends of the shutters.
 - .1 Seals, of synthetic material, nested on the studs of the frame.
- .3 Performance characteristics, with respect to minimum leakage, meeting or exceeding the nominal values given in AMCA Standard 500-D.

- .1 Dimensions/flow rate as indicated in the I/O summary report.
- .2 Maximum permissible leakage of the order of 25 L/s/m² at a static pressure of 1000 Pa, for externally mounted air intake and extraction dampers.
- .3 Temperature measurement range -40 °C to 100 °C.
- .4 Fitting: hot/cold air mixing dampers mounted at right angles to each other, fitted with parallel flaps, the mixture being subject to the degree of opening of the flaps.
- .5 Intermediate trees
 - .1 Solid shafts of diameter 25 mm in diameter, of anti-corrosion metal, with the necessary number of bearings to support them and allow the flaps to move throughout their travel.
 - .2 Connection to the control linkage by means of anti-corrosion elements.
 - .3 Installation according to manufacturer's instructions.
 - .4 From the same manufacturer as the different registry sections .

2.23 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 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.24 WATTHOUR METERS AND CURRENT TRANSFORMERS

- .1 Features
 - .1 Current test sockets and terminal blocks, all three-phase, necessary for connecting watt-hour meters and for checking the current intensity. Two transformers operating on three-wire circuit, 600 V. Accuracy of the order of +/- 0.25% of full scale. In the case of chillers, instantaneous indicator with analog or digital display.
 - .2 ANSI C12.7 Watt-hour meter bases
 - .3 Current and voltage transformers compliant with ANSI/IEEE C57.13
 - .4 Two primary fuses for voltage transformers.
 - .5 Maximum indicators configured to measure demand at 15-minute intervals.

2.25 PANELS

- .1 Free-standing wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Department Representative's without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.26 WIRING

- .1 In accordance with Section 26 27 10 - Modular Wiring System 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 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

3 EXECUTION

3.01 INSTALLATION

- .1 Install equipment, components so that manufacturers 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, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, 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 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Department Representative before beginning Work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .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.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Department Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.
- .8 Mechanical: supply and install in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.
- .9 VAV Terminal Units: supply, install and adjust as required.
 - .1 Air probe, actuator and associated vav controls.
 - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
 - .3 Co-ordinate air flow adjustments with balancing trade.

3.02 TEMPERATURE AND HUMIDITY 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 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
- .4 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.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 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.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.03 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.

3.04 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Department Representative.
- .2 Locations: as indicated as specified.

3.05 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
- .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.06 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.07 AIR PRESSURE GAUGES

- .1 Mount a pressure gauge on pneumatic devices, including current/pressure transducers, pilot light positioners, motor controls, regulators, contactors, relays, valves, and damper and valve positioners.
- .2 Mount a pressure gauge at the outlet of the pneumatic components connected to the regulators and auxiliary housings.

3.08 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.09 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 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

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
 - .1 Control Description Logic (CDL) for each system.
 - .2 Input/Output Point Summary Tables for each system.
 - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.02 REFERENCE STANDARDS

- .1 Public Works and Government Services Canada (PSPC) / 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/doccentre/mechanical/me214-e.pdf>

1.03 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.
 - .1 .
- .2 Sequencing of operations for systems as follows:
 - .1 Humidifier HU-1:
 - a. The relative humidity set point is set to 30% (adjustable).
 - b. The centralized control system sends a signal to the humidifier controller to maintain the relative humidity set point in the supply air.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 AINSI NORMS
 - .1 TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- .2 ULC Group
 - .1 CAN/ULC-S524, Standard for Installation of Fire Alarm Systems 5th edition
 - .2 CAN/ULC-S524-14 6-th Edition - Standard For Installation of Fire Alarm Systems
 - .3 CAN/ULC S524, Standard for the Installation of Fire Alarm Systems
 - .4 CAN/ULC-S536-13, Standard for Inspection and Testing of Fire Alarm Systems
 - .5 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems
 - .6 CAN/ULC-S537 - Installation and Services - Fire Alarm Reception Systems and Stations
- .3 The Electrical Equipment Manufacturers Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .4 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No.1-10, Overhead Systems.
 - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .4 C22.10-F10 – Quebec construction code, Chapter V – Electricity –Canadian electrical code, first part (23rd edition) and quebec modifications
 - .5 C22.1-15 - Electricity –Canadian electrical code first part (23rd edition), safety standard for electrical installations
 - .6 CAN/CSA-B72-M87 (R2013) - Installation Code for Lightning Protection Systems
 - .7 CAN/CSA-Z462-18 - Workplace electrical safety
- .5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.6 Seismic standard

.7 Technical Criteria for Correctional Facilities - April 2015

1.02 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.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets. Include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit for review single line electrical diagrams under plexiglass and locate as indicated.

.1 Electrical distribution system in main electrical room.

.2 Electrical power generation and distribution systems in power plant rooms.

.3 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.

.4 Shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, 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 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 Submit 3 number of copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction inspection authorities.

.6 If changes are required, notify Departmental Representative of these changes before they are made.

.5 Certificates:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction 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 Departmental Representative.

- .7 Manufacturer's Field Reports: submit to Departmental 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.
- .8 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.04 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.

1.05 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 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 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 and French.
- .4 Use one nameplate for each language.

2.02 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction 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.

2.03 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.04 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

2.05 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.06 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicooid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core
 - .2 Sizes as follows:

<u>NAMEPLATE SIZES</u>			
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 Departmental 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 "as directed by Departmental 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.

2.07 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered colored 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.

2.08 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

<u>Type</u>	<u>Prime</u>	<u>Auxiliary</u>
- 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 communication systems	Green	Blue
- Fire Alarm	Red	
- Emergency	Red	Blue
- Voice		
- Other security system	Red	Yellow

2.09 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 to.
 - .2 Paint indoor switchgear and distribution enclosures light gray to.

3 EXECUTION

3.01 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 Departmental Representative.

- .2 Inform Departmental 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 Departmental Representative.

3.02 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.

3.03 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.04 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete plastic pipe, sized for free passage of conduit, and protruding 50 mm.
- .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.

3.05 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.06 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centerline 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: 1370 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 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: 1500 mm.
 - .6 Fire alarm stations: 1370 mm.
 - .7 Fire alarm bells: 2100 mm.
 - .8 Television outlets: 300 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Doorbell pushbuttons: 1370 mm.

3.07 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .2 Using shop drawings from the main switchboard, provide the protection coordination study, including the Departmental Representative's protective device, main breaker, and secondary breakers.

3.08 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 centers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

- .5 Systems: fire alarm communications.
- .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental 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.

3.09 SYSTEM STARTUP

- .1 Instruct Departmental 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 11 - 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 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 ARC FLASH HAZARD

- .1 Live working.
 - .1 Work on live equipment must be performed in accordance with CSA Z462 "Workplace Electrical Safety". Refer to Tables 1 and 4 in CSA Z462
 - .2 The Contractor must obtain acceptance from the site manager before starting the live work.
- .2 Marking "Danger of electric arc"
 - .1 Supply and install a label on all electrical equipment (except those that comply with Clause 4.3.3.1 of CSA Z462), as requested by CCQ-E and type "Figure Q. 1 ", as shown in Annex Q of CSA Z462.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of electrical communications and safety and security 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.

1.02 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures

1.03 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 Department 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.

1.04 RELATED REQUIREMENTS

- .1 Section 02 41 19.13 - Selective Building Demolition
- .2 Section 02 41 19.16 - Selective Interior Demolition
- .3 Section 02 41 00.08 - Demolition - Minor Works
- .4 Section 02 42 00 - Removal and Salvage of Construction Materials

1.05 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 and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Department Representatives continued occupancy requirements during selective demolition with Section 02 41 19.13 - Selective Building Demolition and schedule staged occupancy and worksite activities as a defined Critical Path in Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) Activity in Section 01 32 16.19 - Construction Progress Schedule - Bar (GANNT) Chart.

1.07 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Federal Workers' Compensation Service Provincial/Territorial Workers' Compensation Boards/Commissions
 - .2 Government of Canada, Labour Program: Workplace Safety Provincial/Territorial Occupational Health and Safety Standards and Programs

1.08 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 at time of site examination before tendering.
- .2 Existing Hazardous Substances: Department Representative performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in Work
 - .1 Hazardous substances will be removed by a hazardous abatement specialist engaged by Department Representative before start of Work.
- .3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Department 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 Department Representative under a separate contract or as a change to Work.

- .6 Proceed only after written instructions have been received from Department Representative

1.09 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 Department Representative
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials

2 PRODUCTS

2.01 MATERIALS

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.13 - Selective Building Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 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
- .3 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.

3 EXECUTION

3.01 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; Department 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.

3.02 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 Department 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: Sequence demolition work so that interference with the use of the building by the Department Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify Department Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.03 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section with information contained in Section 02 41 19.13 - Selective Building 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, 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.
 - .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.

3.04 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 02 42 00 - Removal and Salvage of Construction Materials

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 74 19 - Waste Management and Disposal

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.04 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.

1.05 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 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal and Section 01 35 21 - LEED Requirements.

2 PRODUCTS

2.01 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 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 conductor's tubes bars as indicated.
- .4 Clamps or connectors for armored cable, TECK cable aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

3 EXECUTION

3.01 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 Departmental Representative.
 - .2 Inform Departmental 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 Departmental Representative.

3.02 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 74 21 - Waste Management and Disposal

1.02 REFERENCE STANDARDS

- .1 Not used.

1.03 PRODUCT DATA

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

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, without jacket.

2.02 TECK 90 CABLE

- .1 Not used.

2.03 MINERAL-INSULATED CABLES

- .1 Not used

2.04 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Type: ACWU90 PVC jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

2.05 ALUMINUM SHEATHED CABLE

- .1 Not used.

2.06 CONTROL CABLES

- .1 Not used.

2.07 NON-METALLIC SHEATHED CABLE

- .1 Not used.

3 EXECUTION**3.01 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.02 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 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.
- .8 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.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.03 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 33 .
 - .3 In underfloor distribution system in accordance with Section 21 .
 - .4 In cellular floor raceways in accordance with Section 21 .
 - .5 In surface and lighting fixture raceways in accordance with Section 26 .
 - .6 In wireways and auxiliary gutters in accordance with Section 21 .
 - .7 Overhead service conductors in accordance with Section 21 .

3.04 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Not used

3.05 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Not used

3.06 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.07 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Not used

3.08 INSTALLATION OF CONTROL CABLES

- .1 Not used

3.09 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Not used

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 26 05 32 - Outlet boxes, conduit boxes and fittings
- .2 Section 26 05 33 - Raceway and boxes for electrical systems

1.02 REFERENCE STANDARDS

- .1 Groupe CSA
 - .1 CSA C22.1-F12, Code canadien de l'électricité, Première partie (22e édition), Normes de sécurité relatives aux installations électriques.
 - .2 CSA C22.2 number 41-F13, Matériel de mise à la terre et de mise à la masse (norme trinationale avec NMX-J-590-ANCE et UL 467).
 - .3 CSA C22.2 number 65-F13, Connecteurs de fils (norme trinationale avec UL 486A-486B et NMX-J-543-ANCE).

1.03 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 connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from Departmental Representative and include it with maintenance manuals.

1.04 CLOSEOUT SUBMITTALS

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

1.05 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 connectors and terminations from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal and Section 01 35 21 - LEED Requirements.

2 PRODUCTS

2.01 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 234 way joint boxes in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- .3 234 way junction boxes with respective pothead for 2 3 4 conductor cables with allowance for stress - cone beyond for X - linked polyethylene butyl rubber cable with aluminum sheath, and overall jacket in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.

3.03 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 23rd Edition.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.03 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 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.02 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

- .5 Extension and plaster rings for flush mounting devices in finished tile walls.

2.03 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.04 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.05 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 27 mm conduit. Minimum size: 73 mm deep.

2.06 CONDUIT BOXES

- .1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.07 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.09 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 pieces stainless steel with brushed housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.
- .2 Pedestal type 'low tension' fitting made of 2 pieces stainless steel with brushed housing finish to accommodate two amphenol jack connectors.

3 EXECUTION

3.01 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armored 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

1 GENERAL

1.01 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 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 Quebec, Canada.

1.02 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in moisture free location.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

1.03 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 600 A.
- .3 Six spare fuses of each type and size installed up to and including 600 A.

2 PRODUCTS

2.01 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.

2.02 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.

3 EXECUTION

3.01 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 26 24 02 – Service entrance board

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Include time-current characteristic curves for breakers with ampacity of 60 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .3 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. 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 Departmental 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 Departmental Representative. Unless complying with this requirement, Departmental 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:

- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Regional Materials: submit evidence that project incorporates required regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.04 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 Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 BREAKERS GENERAL

- .1 Moulded-case circuit breakers and ground-fault circuit-interrupters and accessory high-fault protectors: 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 symmetrical effective at 347 / 600V, 10kA symmetrical effective at 120 / 208V or as indicated in plans.

2.02 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.

2.03 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.

2.04 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS (DESIGN C)

- .1 Thermal magnetic breakers with current limiters.
 - .1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.
 - .2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.
- .2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
 - .1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.05 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 longtime short time instantaneous tripping for phase ground fault short circuit protection.

2.06 OPTIONAL FEATURES

- .1 Include:
 - .1 Shunt trip.
 - .2 Auxiliary switch.
 - .3 Motor-operated mechanism c/w time delay unit.
 - .4 Under-voltage release.
 - .5 On-off locking device.
 - .6 Handle mechanism.

3 EXECUTION

3.01 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 Departmental Representative.
 - .2 Inform Departmental 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 Departmental Representative.

3.02 INSTALLATION

.1 Install circuit breakers as indicated.

3.03 CLEANING

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

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 26 24 02 - Service entrance board

1.02 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuse holder Assemblies.
- .2 NEMA KS1

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.04 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 by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Waste Management and Disposal.

2 PRODUCTS

2.01 DISCONNECT SWITCHES

- .1 Fusible or Non-fusible, disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by 1 lock.
- .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 Fuse holders: to CSA C22.2 No.39relocatable and 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.
- .8 Switches must be proven for intensive use and for use in motor circuits (horsepower rating).

2.02 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.

3 EXECUTION

3.01 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 Departmental Representative.
 - .2 Inform Departmental 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 Departmental Representative.

3.02 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION