

PROJECT TITLE _____ Grand Valley Institute for Women
1575 Homer Watson Blvd.
Kitchener, Ontario
Principal Entrance Building

PROJECT NUMBER _____ R.047995.001

PROJECT DATE _____ 2013-10-04

END OF SECTION

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END OF SECTION

Part 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises construction at the Grand Valley Institution for Women, 1575 Homer Watson Blvd. Kitchener, Ontario. Work includes construction of a new, 1,350m², two storey steel framed Principal Entrance Building (PEB) on the south side of the existing Staff and Visitors entrance to the facility. Work will also include renovations to approximately 700m² of the existing Area A Wing of the Institution as well as upgrades to the Building Management System for the Area A, B, C and D of the Institution. All work will be completed under one contract.
- .2 The scope of work also includes construction of new and existing parking areas, main entrance driveway and related site works such as lighting and security fencing. Access to the Institution, Emergency Vehicle access and Staff and Visitor parking shall be maintained at all times.
- .3 All work shall be completed while maintaining perimeter security for the Institution including all Intrusion Detection Systems, security camera systems as well as security lighting.

1.2 CONTRACT METHOD

- .1 Construct Work under contract.

1.3 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Departmental Representative's intermittent use of premises during construction.
 - .2 Coordinate Progress Schedule and coordinate with Departmental Representative Occupancy during construction.
 - .3 Required stages: Refer to Phasing Plans.
 - .1 A temporary security fencing system and perimeter security shall be installed and approved by the Departmental Representative before any Work for the PEB commences. The security fencing shall be maintained at all times as required by the Departmental Representative.
 - .2 The construction of the PEB shall be completed and occupied by CSC before Departmental Representative will approve Work to commence in the existing building. All new security fencing and systems shall be completed and commissioned before temporary security is removed.
 - .3 All Work for the renovations to the existing building and the Building Management Systems shall be completed in accordance with the Special Project Procedures of CSC.
 - .4 All Work for parking, driveway access and exterior works shall be completed in accordance with schedule approved by the Departmental Representative.
-

1.4 CONTRACTOR USE OF PREMISES

- .1 Contractor has use of the site in accordance with the phasing plan included with the Contract Documents.
- .2 Coordinate 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.

1.5 OWNER OCCUPANCY – PHASE 2

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.6 ALTERATIONS TO EXISTING BUILDING

- .1 Remove, temporarily store, clean, alter to suit and reinstall:
 - .1 Metal stair
 - .2 T-Bar lighting fixtures
- .2 Provide new openings required in existing construction.
- .3 Block in openings where items removed with material and finish to match existing adjoining construction.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 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 Departmental 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 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 building operations, occupants, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.4 EXISTING SERVICES

- .1 Notify, Departmental Representative utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, request Departmental Representative's approval at least one (1) week prior to necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum.
- .3 Provide for personnel and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00.

1.5 SPECIAL REQUIREMENTS

- .1 Paint and carpet public or occupied areas Monday to Friday from 08:00 to 17:00 hours only.
 - .2 Carry out noise generating Work Monday to Friday from 08:00 to 17:00 hours.
 - .3 Submit schedule in accordance with Section 01 32 16.
 - .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
 - .5 Keep within limits of work and avenues of ingress and egress.
 - .6 Deliver materials outside of peak traffic hours 07:45 to 11:00 and 13:00 to 15:30 unless otherwise approved by Departmental Representative.
-

- .7 “Construction Limits” means the area as shown on the contract drawings that the Contractor will be allowed to work. This area may or may not be isolated from the security area of the Institution.

1.6 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted on CSC property.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 APPOINTMENT AND PAYMENT

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

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work for inspection and testing.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify Departmental Representative 48 hours minimum sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.
-

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 ADMINISTRATIVE

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

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
 - .2 Departmental 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 Section 01 32 16.
 - .3 Schedule of submission of shop drawings, samples, mock-ups, colour chips. Submit submittals in accordance with Section 01 33 00.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00.
 - .5 Delivery schedule of specified equipment in accordance with Section 01 32 16.
 - .6 Site security in accordance with Section 01 56 00.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .8 Departmental Representative provided products.
 - .9 Record drawings and specifications in accordance with Section 01 33 00.
-

- .10 Maintenance manuals in accordance with Section 01 78 00.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

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

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.
-

END OF SECTION

Part 1 GENERAL

1.1 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Certificate of Substantial Performance and Certificate of Completion as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

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

- .2 Submit to Departmental Representative within 10 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows for Phase 1 and Phase 2:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Excavation.
 - .6 Backfill.
 - .7 Building footings.
 - .8 Slab on grade.
 - .9 Structural Steel.
 - .10 Siding and Roofing.
 - .11 Interior Architecture (Walls, Floors and Ceiling).
 - .12 Plumbing.
 - .13 Lighting.
 - .14 Electrical.
 - .15 Piping.
 - .16 Controls.
 - .17 Heating, Ventilating, and Air Conditioning.
 - .18 Millwork.
 - .19 Fire Systems.
 - .20 Testing and Commissioning.

1.6 PROJECT SCHEDULE REPORTING

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

- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.7 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to Departmental 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 prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental 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 of Ontario of 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 co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
 - .4 Allow 5 working days for Departmental Representative's review of each submission.
 - .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
-

- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental 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 shall 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 field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
 - .9 After Departmental Representative's review, distribute copies.
 - .10 Submit one transparency on plastic film three hard copies and one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
 - .11 Submit three hard copies and one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
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- .12 Submit three hard copies and one electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental 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 three hard copies and one electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
 - .14 Submit three hard copies and one electronic copy of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
 - .15 Submit three hard copies and one electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental 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 three hard copies and one electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
 - .18 Supplement standard information to provide details applicable to project.
 - .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, transparency 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.
 - .20 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PWGSC 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 job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.
-

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 Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental 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 MOCK-UPS

- .1 Erect mock-ups in accordance with Section 01 45 00.

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic and hard copy of colour digital photography in jpg format, fine resolution monthly with progress statement and as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 8 locations.
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly and as directed by Departmental Representative.
 - .1 Upon completion of: excavation, foundation, framing and services before concealment, of Work, and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit WorkPLACE' Safety and Insurance Board (WSIB) Experience Report.
- .2 Submit transcription of insurance immediately after award of Contract.

1.7 FEES, PERMITS AND CERTIFICATES

- .1 Provide authorities having jurisdiction with information requested.
 - .2 Pay fees and obtain certificates and permits required.
 - .3 Furnish certificates and permits.
-

- .4 Submit acceptable certificate stating that suspended ceiling systems provide adequate support for electrical fixtures, as required by current bulletin of Electrical Inspection Department of Ontario Hydro.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 PURPOSE

- .1 To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

1.2 DEFINITIONS

- .1 "Contraband" means:
 - .1 An intoxicant, including alcoholic beverages, drugs and narcotics.
 - .2 Tobacco or associated tobacco products.
 - .3 An igniting device, lighter or matches.
 - .4 A weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization.
 - .5 An explosive or a bomb or a component thereof.
 - .6 Currency over any applicable prescribed limit, \$50 when possessed by an inmate without prior authorization.
 - .7 Any item not described in paragraphs 1.2.1.1 to 1.2.1.6 that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 "Unauthorized Smoking and related Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 "CSC" means Correctional Service Canada.
- .5 "Director" means Director, Warden or Superintendent of the Institution as applicable.
- .6 "Construction Employees" means persons working for the General Contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .7 "Departmental Representative" means the project manager from Public Works and Government Services Canada.
- .8 "Perimeter" means the fenced or walled area of the Institution that restrains the movement of the inmates.
- .9 "Construction Limits" means the area as shown on the contract drawings that the Contractor will be allowed to work. This area may or may not be isolated from the security area of the Institution.

1.3 PRELIMINARY PROCEEDINGS

- .1 Prior to the commencement of work, the Contractor shall meet with the Director or his/her representative to:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 Contractor shall:
 - .1 Ensure that all Construction Employees are aware of the security requirements.
 - .2 Ensure that a copy of the security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all Construction Employees.

1.4 CONSTRUCTION EMPLOYEES

- .1 Submit to the Director a list of the names with date of birth of all Construction Employees to be employed on the construction site and a security clearance form for each employee.
- .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC Institutions are not valid at this Institution.
- .3 The Director may require that facial photographs may be taken of Construction Employees and these photographs may be displayed at appropriate locations in the Institution or in an electronic database for identification purposes. The Director may require that Photo ID cards be provided for all Construction Employees. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the Construction Employees' clothing at all time while Construction Employees are in the institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
 - .1 Appear to be under the influence of alcohol, drugs or narcotics.
 - .2 Behave in an unusual or disorderly manner.
 - .3 Are in possession of contraband.
- .6 Smoking is prohibited anywhere on CSC property.

1.5 VEHICLES

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
 - .2 The Director may limit at any time the number and type of vehicles allowed within the Institution.
-

- .3 Drivers of delivery vehicles for material required by the project will not require security clearances but must remain with their vehicle the entire time that the vehicle is in the Institution. The Director may require that these vehicles be escorted by Institutional Staff or Commissionaires while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors will be locked at all times. All windows will be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter shall be locked when not in use.

1.6 PARKING

- .1 Parking area(s) to be used by Construction Employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.

1.7 SHIPMENTS

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the Institution's own shipments. The Contractor must have his/her own employees on site to receive any deliveries or shipments. CSC staff will NOT accept receipt of deliveries or shipments of any material, equipment or tools.

1.8 TELEPHONES

- .1 There will be no installation of telephones, Facsimile machines and computers with Internet connections permitted within the perimeter of the Institution unless prior approval of the Director is received.
- .2 The Director will ensure that approved telephones, facsimile machine and computers with internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an internet connection to unauthorized personnel.
- .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, BlackBerries, telephone used as 2-way radios, are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.
- .4 The Director may approve but limit the use of two way radios.

1.9 WORK HOURS

- .1 Work hours within the Institution are: Monday to Friday 08:00 hrs. to 17:00 hrs.
 - .2 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by the Director.
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1.10 OVERTIME WORK

- .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such as the completion of a concrete pour or work to make the construction safe and secure, the Contractor shall advise the Director as soon as this condition is known and follow the directions given by the Director. Costs to the Crown for such events may be attributed to the Contractor.
- .2 When overtime work, weekend, or statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his/her designate, to maintain the security surveillance. The Departmental Representative may post extra staff for inspection of construction activities. The actual cost of this extra staff may be subject to reclamation by the Crown.

1.11 TOOLS AND EQUIPMENT

- .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
 - .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
 - .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
 - .4 Store all tools and equipment in approved secure locations.
 - .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the Contractor. Scaffolding shall be secured and locked when not erected and when erected, will be secured in a manner agreed upon with the Institutional designate.
 - .6 All missing or lost tools or equipment shall be reported immediately to the Director.
 - .7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
 - .1 At the beginning and conclusion of every construction project.
 - .2 Weekly, when the construction project extends longer than a one week period.
 - .3 The Contractor may be subject to random checks by security staff to ensure proper storage and security of tools throughout the project.
 - .8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The Contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day.
 - .9 If propane or natural gas is used for heating the construction, the Institution will require that an employee of the Contractor supervise the construction site during non-working hours.
-

- .10 If torches or grinders are required tools to perform Work, Contractor must complete a Hot Work Permit as supplied by CSC. Completed original form(s) are copied and posted on the work site in a conspicuous location. Original documents are to remain with the Institutional Fire Chief.

1.12 KEYS

- .1 Security Hardware Keys:
- .1 The Contractor shall arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).
 - .2 The Security Maintenance Officer (SMO) will provide a receipt to the Contractor for security hardware keys.
 - .3 The Contractor will provide a copy of the above-mentioned receipt to the Departmental Representative.
- .2 Other Keys:
- .1 The Contractor will use standard construction cylinders for locks for his/her use during the construction period.
 - .2 The Contractor will issue instructions to his/her employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
 - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
 - .1 Prepare an operational keying schedule.
 - .2 Accept the operational keys and cylinders directly from the lock manufacturer
 - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
 - .3 Upon putting operational security keys into use, the CSC construction escort shall obtain these keys as they are required from the Security Maintenance Officer (SMO) and open doors as required by the Contractor. The Contractor shall issue instructions to his/her employees advising them that all security keys shall always remain with the CSC construction escort.

1.13 SECURITY HARDWARE

- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.

1.14 PRESCRIPTION DRUGS

- .1 Employees of the Contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

1.15 SMOKING RESTRICTIONS

- .1 Contractors and construction employees are not permitted to smoke inside correctional facilities or outdoors within the perimeter of a correctional facility and must not possess unauthorized smoking items within the perimeter of a correctional facility.

- .2 Contractors and construction employees who are in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist, will be directed to leave the institution.
- .3 Smoking is only permitted outside the perimeter of a correctional facility in an area to be designated by the Director.

1.16 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on Institutional Property.
- .2 Discovery of Contraband on the construction site and the identification of the person(s) responsible for the Contraband shall be reported immediately to the Director.
- .3 Contractors shall be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of Contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of Contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

1.17 SEARCHES

- .1 All vehicles and persons entering Institutional property may be subject to search.
- .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of Contraband or unauthorized items, he/she may order that person to be searched.
- .3 All employees entering the Institution may be subject to screening of personal effects for traces of Contraband drug residue.

1.18 ACCESS TO AND REMOVAL FROM INSTITUTION PROPERTY

- .1 Construction personnel and commercial vehicles will not be admitted to the Institution after normal working hours, unless approved by the Director.

1.19 MOVEMENT OF VEHICLES

- .1 Escorted commercial vehicles will be allowed to enter or leave the Institution through the vehicle access gate during the following hours:
 - .1 07:45 hrs. to 11:00 hrs.
 - .2 13:00 hrs. to 15:30 hrs.
- .2 Construction vehicles shall not leave the Institution until an inmate count is completed.
- .3 The Contractor shall advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .4 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC Staff or Commissionaires working under the authority of the Director.

- .5 Commercial Vehicles will only be allowed access to Institutional Property when their contents are certified by the Contractor or his/her representative as being strictly necessary to the execution of the construction project.
- .6 Vehicles shall be refused access to Institutional Property if, in the opinion of the Director, they contain any article which may jeopardize the security of the Institution.
- .7 Private vehicles of Construction Employees will not be allowed within the security wall or fence of medium or maximum security Institutions without the permission of the Director.
- .8 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .9 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.

1.20 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his/her employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may:
 - .1 Prohibit or restrict access to any part of the Institution.
 - .2 Require that in certain areas of the Institution, either during the entire construction project or at certain intervals, Construction Employees only be allowed access when accompanied by a member of the CSC security staff.
- .3 During the lunch and coffee/health breaks, all employees will remain within the construction site. Employees are not permitted to eat in the officer's lounge and dining room.

1.21 SURVEILLANCE AND INSPECTION

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among Construction Employees and maintained throughout the construction project.

1.22 STOPPAGE OF WORK

- .1 The Director may request at any time that the Contractor, his/her employees, sub-contractors and their employees not enter or leave the work site immediately due to a security situation occurring within the Institution. The Contractor's site supervisor shall note the name of the staff member making the request and the time of the request and obey the order as quickly as possible.
 - .2 The Contractor shall advise the Departmental Representative within 24 hours of this delay to the progress of the work.
-

1.23 CONTACT WITH INMATES

- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his/her security clearance revoked.
- .2 It is forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this Contract.

1.24 COMPLETION OF CONSTRUCTION PROJECT

- .1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the Institution as part of the construction contract.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA): Canada
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code 2010 (NBC):
 - .1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
- .3 National Fire Code 2010 (NFC):
 - .1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.
- .4 Province of Ontario:
 - .1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.
 - .2 O. Reg. 490/09, Designated Substances.
 - .3 Workplace Safety and Insurance Act, 1997.
 - .4 Municipal statutes and authorities.
- .5 Treasury Board of Canada Secretariat (TBS):
 - .1 Treasury Board, Fire Protection Standard April 1, 2010
www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316§ion=text.
- .6 Fire Commissioner of Canada (FCC):
 - .1 FC-301 Standard for Construction Operations, June 1982.
 - .2 FC-302 Standard for Welding and Cutting, June 1982.
Labour Program
Fire Protection Engineering Services
4900 Yonge Street 8th Floor
North York, Ontario M2N 6A8
and copies may be obtained from:
Human Resources and Social Development Canada
Labour Program
Fire Protection Engineering Services
Ottawa, Ontario K1A 0J2

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
 - .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
-

- .2 Results of safety and health risk or hazard analysis for site tasks and operations found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
- .4 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.
- .5 Submit copies of incident and accident reports.
- .6 Departmental Representative will review Contractor's site specific Health and Safety Plan and provide comments to Contractor within 10 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .7 Departmental Representative's review of Contractor's Final Health and Safety Plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to commencement of Work.

1.4 SAFETY ASSESSMENT

- .1 Perform 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.

1.6 REGULATORY REQUIREMENTS

- .1 Comply with the Acts and regulations of the Province of Ontario.
- .2 Comply with specified standards and regulations to ensure safe operations at site.

1.7 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or requesting improvements.

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990 Chapter 0.1, as amended.
-

1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 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 Health and Safety Plan.
- .3 Where applicable the Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act for the Province of Ontario.

1.10 UNFORSEEN HAZARDS

- .1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Departmental Representative verbally and in writing.
- .2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

1.11 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have working knowledge of occupational safety and health regulations.
 - .2 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 site to perform Work.
 - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .4 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province of Ontario, and in consultation with Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

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

1.15 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Director.

1.16 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

- .1 This section specifies general requirements and procedures for fire safety. Additional requirements may be specified in individual sections elsewhere in specifications.

1.2 REPORTING FIRES

- .1 The Departmental Representative will co-ordinate arrangements for the Contractor to be briefed at the pre-construction meeting concerning Building's fire safety protocol.
- .2 Building Manager will supply a copy of "Fire Safety Emergency Evacuation Plan" in effect for this building. Contractor shall comply with outlined fire safety requirements.
- .3 Know location of nearest fire alarm box and telephone, including emergency phone number.
- .4 Report immediately all fire incidents to Fire Department as follows:
 - .1 activate nearest fire alarm box; or
 - .2 telephone.
- .5 Person activating fire alarm box will remain at box to direct Fire Department to scene of fire.
- .6 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify the location.

1.3 FIRE WATCH

- .1 Appoint a Fire Watch at locations where welding and soldering, torching or roofing is to take place.
- .2 A dedicated Fire Watch is not required. A competent person from the workforce on site may be assigned as Fire Watch for duration of work.
- .3 Assign a person who is knowledgeable in the correct use of fire extinguishers on the project.
- .4 Have work inspected by the Fire Watch up to 1.5 hours after work stoppage for each work period.

1.4 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

- .1 Fire protection and alarm system will not be:
 - .1 obstructed;
 - .2 shut-off; or
 - .3 left inactive at end of working day or shift.
 - .2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting purposes unless authorized by Departmental Representative.
 - .3 Provide and maintain free access to fire extinguishing equipment. Maintain exit facilities. Keep means of egress free from materials, equipment and obstructing.
-

1.5 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as necessary to protect work in progress and contractor's physical plant on site.

1.6 BLOCKAGE OF ROADWAYS

- .1 Advise Departmental Representative of any work that would impede fire apparatus response. This includes violation of minimum required overhead clearance.

1.7 SMOKING PRECAUTIONS

- .1 Smoking is not permitted within areas of work or site storage.

1.8 RUBBISH AND WASTE MATERIALS

- .1 Rubbish and waste materials are to be kept to a minimum.
- .2 Burning of rubbish is prohibited.
- .3 Remove all rubbish from work site at end of work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove from site daily or at the end of each shift.

1.9 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids are to be governed by the current National Fire Code of Canada.
- .2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of local Building Manager.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat-producing devices.
- .5 Flammable liquids having a flash point below 38°C such as naphtha or gasoline will not be used as solvents or cleaning agents.
- .6 Flammable and combustible waste liquids, for disposal, will be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and Departmental Representative is to be notified when disposal is required.

1.10 HAZARDOUS SUBSTANCES

- .1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, will be in accordance with National Fire Code of Canada.
-

- .2 Obtain from local Building Manager a "Hot Work" permit for work involving welding, burning or use of blow torches and salamanders, in buildings or facilities.
- .3 When Work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the local Building Manager. Contractors are responsible for providing fire watch service for work on a scale established and in conjunction with Building Manager at pre-construction meeting.
- .4 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation will be assured and all sources of ignition are to be eliminated. Building Manager is to be informed prior to and at cessation of such work.

1.11 WELDING, BURNING AND CUTTING

- .1 Contractor performing work of this section must notify Departmental Representative in advance of commencing work.
- .2 Use non-combustible shields for electric and gas welding or cutting executed within 3 m of combustible material or in occupied spaces.
- .3 Place cylinders supplying gases as close to work as possible. Secure cylinders in upright position, free from exposure to sun or high temperature.
- .4 Locate fire extinguishing equipment near all welding, cutting and soldering operations.
- .5 Contractor's mechanics shall be properly equipped with required protective clothing, including goggles or welding hood or face mask, gloves, etc.
- .6 Contractor is responsible for the protection of his work and the Departmental Representative's property.
- .7 Provide Fire Watch on standby with approved fire extinguisher while burning or welding is in progress.

1.12 QUESTIONS AND/OR CLARIFICATIONS

- .1 Direct any questions or clarification on Fire Safety in addition to above requirements to local Building Manager.

1.13 FIRE INSPECTION

- .1 Site inspections by Building Manager will be coordinated through Departmental Representative.
- .2 Allow local Building Manager unrestricted access to work site.
- .3 Co-operate with Building Manager during routine fire safety inspection of work site.
- .4 Immediately remedy all unsafe fire situations observed by Building Manager.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .3 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
 - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
 - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.

- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

1.3 FIRES

- .1 Fires and burning of rubbish on site is not permitted.

1.4 DRAINAGE

- .1 Develop and submit Erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
 - .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
 - .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
 - .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
 - .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
-

1.5 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Departmental Representative.

1.6 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.7 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.
-

Part 3 EXECUTION

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2010, National Fire Code of Canada (NFC) 2010 and Ontario Building Code (OBC) 2006, including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Stop work immediately and notify Departmental Representative if materials which may contain designated substances or PCB's, are discovered in course of work.

1.3 IAQ - INDOOR AIR QUALITY

- .1 Comply with CSA-Z204-94(R1999), Guideline for Managing Indoor Air Quality in Office Buildings.

1.4 ACCESSIBLE DESIGN

- .1 Comply with CSA B651-12, Accessible Design for the Built Environment, unless specified otherwise. In any case of conflict or discrepancy between the building codes and CSA B651, the requirements of CSA B651 shall apply.

1.5 STATISTICAL INFORMATION

- .1 Provide statistical information to Departmental Representative:
 - .1 Within ten working days after March 31 and September 30 occurring between commencement of work and final completion.
 - .2 Within ten working days after final completion.
- .2 Include in statistical information:
 - .1 Statement of total person days of labour used on site in performance of contract, including labour provided under sub-contracts.
 - .2 Estimate of total value in dollars of material delivered to site and installed, including material provided and installed under sub-contracts.
- .3 This information is required by Government of Canada solely to provide statistics that will aid in assessing socio-economic benefits of this project.

1.6 TAXES

- .1 Pay applicable Federal, Provincial and Municipal taxes.
-

1.7 EXAMINATION

- .1 Examine existing conditions and determine conditions affecting work.
- .2 Conduct concrete floor moisture testing using Calcium Chloride moisture tests.
 - .1 Submit test results to Departmental Representative for approval prior to installing any flooring. Conduct one test per 100 m² of area being covered.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 ABBREVIATIONS AND ACRONYMS

- .1 The abbreviations and acronyms are commonly found in the Project Manual and represent the associated organizations or terms.

1.2 MATERIALS, EQUIPMENT AND METHODS

- .1 A:
- .2 AC: acoustic.
- .3 ACM: aluminum composite panel
- .4 AC PAN: acoustic panel.
- .5 ACU: acoustic unit ceiling.
- .6 AFF: above finished floor.
- .7 AC PLAS: acoustic plaster.
- .8 ACT: acoustic tile.
- .9 ACR CU LVR: acrylic cube louvre.
- .10 ADH: adhesive.
- .11 ADJ: adjustable.
- .12 A/C: air conditioner.
- .13 AFF: above finished floor
- .14 ALUM: aluminum.
- .15 AB: anchor bolt.
- .16 ANOD: anodized.
- .17 ARCH: architecture.
- .18 ARCH BLK: architectural block.
- .19 A/V: air vapour barrier.
- .2 B:
- .1 B: base.
- .2 BEAST: benthic assessment of sediment.
- .3 BH: bore hole.
- .4 BL: bottom layer.
- .5 BLK: block.
- .6 BLKD: bulkhead.
- .7 BM: beam.
- .8 BO: bollard
- .9 BOT: bottom.
- .10 BMP: best management practice.
- .11 B PL: base plate.
- .12 BRG: bearing.
-

- .13 BRK: brick.
- .14 B/S: both sides
- .15 BSMT: basement.
- .16 BTEX: benzene, toluene, ethylbenzene and xylenes.
- .17 BUR: built-up roof.
- .3 C:
- .1 CAL: caliper.
- .2 CANTIL: cantilever.
- .3 CB: catch basin.
- .4 CC: centre to centre.
- .5 CCN: contemplated change notice.
- .6 CDF: controlled density fill.
- .7 CEC: Canadian Electrical Code.
- .8 CF: chair fabric.
- .9 CG: corner guard
- .10 CHAN: channel.
- .11 CHS: Canadian hydrographic service.
- .12 CJ: construction joint.
- .13 CL: centreline.
- .14 CK: cork.
- .15 CLG: ceiling.
- .16 CLR: clear.
- .17 CMU: concrete masonry unit
- .18 COL: column.
- .19 CONC: concrete.
- .20 CONC BLK: concrete block.
- .21 CONC BRK: concrete brick.
- .22 CONT: continuous.
- .23 CONT J: control joint.
- .24 COMPL: complete.
- .25 CM: centimetre. (Nursery stock).
- .26 CPL: cement plaster.
- .27 CPM: critical path method.
- .28 C.P.: composite wall panel
- .29 CPT: carpet.
- .30 CPTT: carpet tile.
- .31 CT: ceramic tile.
- .32 CVT: conductive vinyl tile.
- .33 C/W: complete with.
- .34 CW: curtain wall
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- .4 D:
- .1 D: deep.
 - .2 DD: dutch door.
 - .3 DEG: degree.
 - .4 DF: drinking fountain.
 - .5 DIA: diameter.
 - .6 DIM: dimension.
 - .7 DL: dead load.
 - .8 DMNT: demountable.
 - .9 DP: dampproofing.
 - .10 DR: door.
 - .11 DRP: drapery.
 - .12 DWL: dowel.
- .5 E:
- .1 EA: each.
 - .2 ECF: engineered containment facility.
 - .3 EE: each end.
 - .4 EF: each face.
 - .5 EL: elevation.
 - .6 ELEC: electric.
 - .7 ELEV: elevator.
 - .8 EM: expanded metal.
 - .9 ENCL: enclosure.
 - .10 EP: epoxy coating
 - .11 EQ: equal.
 - .12 EXH: exhaust.
 - .13 EXIST: existing.
 - .14 EXPJ: expansion joint.
 - .15 EXP STRUCT: exposed structure.
 - .16 EXT: exterior.
 - .17 EW: each way.
- .6 F:
- .1 FC: fuel contributed.
 - .2 FD: floor drain.
 - .3 FDN: foundation.
 - .4 FEAT W: feature wall.
 - .5 FEC: fire extinguisher cabinet
 - .6 FEXT: fire extinguisher.
 - .7 FF: finished floor
 - .8 FH: fire hose.
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- .9 FHC: fire hose cabinet.
.10 FHR: fire hose rack.
.11 FIN: finish.
.12 FIP: federal identity program.
.13 FLR: floor.
.14 FLD: field.
.15 FLUOR: fluorescent.
.16 FR: frame.
.17 FRR: fire resistance rating.
.18 FTG: footing.
- .7 G:
- .1 GA: gauge
.2 GALV: galvanized steel.
.3 GB: grab bar.
.4 GBD: gypsum board.
.5 GC: General Conditions.
.6 GF: ground floor.
.7 GFCI: ground fault circuit interrupter.
.8 GL: glass or glazing.
.9 GL BLK: glass block.
.10 GPC: gypsum plaster ceiling.
.11 GPW: gypsum plaster wall.
.12 GT: glass tile.
.13 GYP: gypsum board
- .8 H:
- .1 H: height
.2 HB: hose bib.
.3 H.C.: handicap
.4 HC: hollow core.
.5 HCWD: hollow core wood door.
.6 HD: hand dryer.
.7 HDW: hardware.
.8 HDWD: hardwood.
.9 HM: hollow metal.
.10 HMI: hollow metal insulated
.11 HORIZ: horizontal.
.12 HOR EF: horizontal each face.
.13 HP: high point.
.14 HPA: Hamilton Port Authority.
.15 HR: hour.
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- .16 HRV: heat recovery ventilator.
.17 HT: height.
.18 HTR: heater.
.19 HWT: hot water tank.
.20 HYD: hydrant.
- .9 I:
- .1 ICF: insulated concrete formwork.
.2 ID: inside diameter.
.3 INSUL: insulation.
.4 INTLK: interlock.
- .10 J:
- .1 JT: joint.
- .11 K:
- .1 KPL: kick plate.
- .12 L:
- .1 LAV: lavatory.
.2 LDG: landing.
.3 LG: long.
.4 LINO: linoleum.
.5 LL: live load.
.6 LP: low point
.7 LT: light.
- .13 M:
- .1 MAS: masonry.
.2 MAS FL: masonry flashing.
.3 MAX: maximum.
.4 MBG: metal bar grating.
.5 MCL: metal cube louvre.
.6 MECH: mechanical.
.7 MET: metal.
.8 MET DK: metal deck.
.9 MET FL: metal flashing.
.10 MET GRID CLG: metal grid ceiling.
.11 MET GRTG: metal grating.
.12 MET LIN CLG: metal linear ceiling.
.13 MET T PTN: metal toilet partition.
.14 MH: maintenance hole.
.15 MIN: minimum.
.16 MLP: metal lath and plaster.
-

- .17 MO: masonry opening.
 - .18 MR: marble.
 - .19 MT: metal threshold.
 - .20 MTL: metal
 - .21 MWP: membrane waterproofing.
 - .14 N:
 - .1 NBC: national building code.
 - .2 NF: near face.
 - .3 NFC: national fire code.
 - .4 N.I.C: not in contract.
 - .5 NO: number.
 - .6 NRC: noise reduction coefficient.
 - .7 NRP: non removable pin.
 - .8 NTS: not to scale.
 - .15 O:
 - .1 OBC: Ontario building code.
 - .2 OC: on centre.
 - .3 OD: outside diameter.
 - .4 OPNG: opening.
 - .5 OPR: operator.
 - .6 OVHD: overhead.
 - .7 OWSJ: open web steel joist.
 - .16 P:
 - .1 P: prefinished.
 - .2 PAH: polynuclear aromatic hydrocarbons.
 - .3 PARG: parging.
 - .4 PCC: precast concrete.
 - .5 PCT: porcelain ceramic tile.
 - .6 PED ACS FLG: pedestal access flooring.
 - .7 PERF.: perforated
 - .8 PF: panel fabric.
 - .9 PL: plate.
 - .10 P.LAM: plastic laminate.
 - .11 PLAS: plaster.
 - .12 PLY.WD: plywood.
 - .13 PR: pair.
 - .14 PREFAB: prefabricated.
 - .15 PRE-FIN: prefinished.
 - .16 PRFL: profile.
-

- .17 PSF: pressed steel frame
- .18 PT: paint.
- .19 PTD: paper towel dispenser.
- .20 PTN: partition.
- .21 PVC: polyvinyl chloride.
- .17 Q:
- .1 QTB: quarry tile base.
- .2 QTF: quarry tile floor.
- .3 QTR: quarry tile roof.
- .18 R:
- .1 R: radius.
- .2 RA: return air.
- .3 RAD: radiator
- .4 RB: resilient base.
- .5 RC: reinforced concrete.
- .6 RCPT: receptacle.
- .7 RD: roof drain.
- .8 REF: reference
- .9 REINF: reinforced/reinforcing.
- .10 REQ: required.
- .11 REQT: requirement.
- .12 RFT: rubber floor tile.
- .13 RM: room.
- .14 RO: rough opening.
- .15 RP: radiant panel.
- .16 RRS: recycled rubber sheet.
- .17 RRT: recycled rubber tile.
- .18 RSD: rolling steel door.
- .19 RSF: rubber sheet flooring.
- .20 RTU: roof top unit.
- .21 RWL: rain water leader.
- .19 S:
- .1 SAN SEW: sanitary sewer.
- .2 SCHED: schedule.
- .3 SC: saw cut.
- .4 SCRN: screen.
- .5 SCWD: solid core wood door.
- .6 SD: smoke developed.
- .7 SDT: static dissipative tile.
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- .8 SECT: section.
- .9 SH: sill height.
- .10 SIM: similar.
- .11 SL: sliding.
- .12 SLR: sealer.
- .13 SP: spandrel panel
- .14 SPEC: specification.
- .15 SS: stainless steel.
- .16 STD: standard.
- .17 STL: steel.
- .18 STL BM: steel beam.
- .19 STC: sound transmission classification.
- .20 STL FL DK: steel floor deck.
- .21 STL PL: steel plate.
- .22 STN: stone.
- .23 STRUCT: structure or structural.
- .24 ST SEW: storm sewer.
- .25 SUPP.: supplier
- .26 S&U: stain and urethane.
- .27 S&V: stain and varnish.
- .28 SVT: solid vinyl tile.

- .20 T:
 - .1 T: top.
 - .2 T&B: top and bottom.
 - .3 TCB: turbidity control plan.
 - .4 TEL: telephone.
 - .5 TER: terrazzo.
 - .6 TERT: terrazzo tile.
 - .7 THK: thick.
 - .8 THR: threshold.
 - .9 TMPD: tempered.
 - .10 TOPG: topping.
 - .11 T/O: top of
 - .12 TRANSV: transverse.
 - .13 TYP: typical.

- .21 U:
 - .1 U: urethane.
 - .2 UCUT: undercut.
 - .3 UGRD: underground.
 - .4 ULC: Underwriters Laboratory of Canada

- .5 UNO: unless noted otherwise.
- .6 UOS: unless otherwise specified.
- .7 U/S: underside.
- .8 UR: urinal.
- .22 V:
 - .1 VB: vapour barrier
 - .2 VCF: vinyl coated fabric.
 - .3 VCT: vinyl composition tile.
 - .4 VERT: vertical.
 - .5 VERT B: vertical blinds.
 - .6 VERT EF: vertical each face.
 - .7 VSF: vinyl sheet flooring.
 - .8 VCT: vinyl composite tile.
 - .9 VWC: vinyl wall covering.
- .23 W:
 - .1 W/: with
 - .2 WC: water closet.
 - .3 W-C: wall connectors.
 - .4 WD: wood.
 - .5 WDV: wood veneer.
 - .6 WG: wired glass
 - .7 WH: wall hydrant.
 - .8 WHMIS: workplace hazardous materials information system.
 - .9 WP: waterproofing.
 - .10 WR: washroom.
 - .11 WSIB: workplace safety and insurance board.
 - .12 WT: weight.
 - .13 WTP: water treatment plant.

1.3 STANDARDS ORGANIZATIONS

- .1 Standards writing organizations:
- .2 AA - Aluminum Association.
- .3 ACPA - American Concrete Pipe Association.
- .4 ANSI - American National Standards Institute.
- .5 ASHRAE - American Society of Heating and Refrigerating and Air-Conditioning Engineers.
- .6 ASTM - American Society for Testing and Materials.
- .7 AWI/AWMAC - Architectural Woodwork Institute/Architectural Woodwork Manufacturers Association of Canada.
- .8 AWPA - American Wood Preservers' Association.
- .9 AWWA - American Water Works Association.

- .10 BHMA - Builders Hardware Manufacturers Association.
 - .11 CCMPA - Canadian Concrete Masonry Producers Association.
 - .12 CGSB - Canadian General Standards Board.
 - .13 CNTA - Canadian Nursery Trades Association.
 - .14 CPCA - Canadian Painting Contractors Association.
 - .15 CRCA - Canadian Roofing Contractors Association.
 - .16 CSA - Canadian Standards Association.
 - .17 CSC - Construction Specifications Canada.
 - .18 CSDMA - Canadian Steel Door Manufacturers Association.
 - .19 CSI - Construction Specifications Institute.
 - .20 CSSBI - Canadian Sheet Steel Building Institute.
 - .21 CRCA - Canadian Roofing Contractors Association.
 - .22 DHI - Door and Hardware Insitute.
 - .23 EEMAC - Electrical and Electronic Manufacturer's Association of Canada.
 - .24 ESA - Electrical Safety Authority.
 - .25 FCC - Fire Commissioner of Canada.
 - .26 FSC - Forest Stewardship Council.
 - .27 GANA - Glass Association of North America.
 - .28 HMMA - Hollow Metal Manufacturers Association.
 - .29 IEEE - Institute of Electrical and Electronics Engineers Inc.
 - .30 ISO - International Organization for Standardization.
 - .31 IWFA - International Window Film Association.
 - .32 LEED - LEED Canada, Leadership in Energy and Environmental Design.
 - .33 MPI - Master Painters Insitute.
 - .34 NAAMM - National Association of Architectural Metal Manufacturers.
 - .35 NCPI - National Clay Pipe Institute.
 - .36 NEMA - National Electrical Manufacturers Association.
 - .37 NFPA - National Fire Protection Association.
 - .38 OPSD - Ontario Provincial Standard Drawings.
 - .39 OPSS - Ontario Provincial Standard Specifications.
 - .40 PPI - Plasctics Pipe Insitute.
 - .41 SDI - Steel Door Intitute.
 - .42 SCAQMD - South Coast Air Quality Management District.
 - .43 TIA - Telecommunications Industry Association.
 - .44 TIAC - Thermal Insulation Association of Canada.
 - .45 TTMAC - Terrazzo Tile and Marble Association of Canada.
 - .46 UL - Underwriters Laboratories.
 - .47 ULC - Underwriters Laboratories of Canada.
 - .48 US EPA - United States Environmental Protection Agency.
 - .49 WH - Warnock Hersey.
-

1.4 FEDERAL GOVERNMENT DEPART- MENTS AND AGENGIES

- .1 Departments, agencies and crown corporations.
- .2 CEAA - Canadian Environmental Assessment Agency.
- .3 CSC - Correctional Service Canada.
- .4 CRA - Canada Revenue Agency.
- .5 DND - Department of National Defence.
- .6 EC - Environment Canada.
- .7 FHBRO - Federal Heritage Buildings Review Office.
- .8 HC - Health Canada.
- .9 HCD - Heritage Conservation Directorate.
- .10 LC - Labour Canada.
- .11 PC - Parks Canada.
- .12 PWGSC - Public Works and Government Services Canada.
- .13 RCMP - Royal Canadian Mounted Police.
- .14 TBS - Treasury Board Secretariat.
- .15 TC - Transport Canada.

1.5 PROVINCIAL GOVERNMENT DEPART- MENTS AND AGENGIES

- .1 MOEE - Ontario Ministry of Environment and Energy.
- .2 MOL - Ontario Ministry of Labour.
- .3 MTO and MOT - Ontario Ministry of Transportation.
- .4 TSSA - Technical Standards and Safety Authority.

1.6 INTERNATIONAL GOVERNMENT DEPART- MENTS AND AGENCIES

- .1 DOHMH - New York City Department of Health and Mental Hygiene, USA.
- .2 GSA - Government Services Administration, USA.

1.7 UNITS OF MEASURE METRIC

- .1 The following abbreviations of units of measure are commonly found in the Project Manual:
 - .1 C: Celsius.
 - .2 cm: centimetre.
 - .3 kg: kilogram.
 - .4 kg/m³: kilogram per cubic metre.
 - .5 kN: kilonewton.
 - .6 kPa: kilopascals.
 - .7 kw: kilowatts.
 - .8 l/s: litre per second.
 - .9 m: metre.
 - .10 m³: cubic metre.
-

- .11 mg/kg: milligrams per kilogram.
- .12 mg/L: milligrams per litre.
- .13 mm: millimetres.
- .14 MPa: megapascal.
- .15 NTU: nephelometric turbidity unit.
- .16 ppm: parts per million.
- .17 ug/L: micrograms per litre.
- .18 ug/m³: micrograms per cubic metre.

1.8 UNITS OF MEASURE IMPERIAL

- .1 The following abbreviations of units of measure are commonly found in the Project Manual:
 - .1 F: Fahrenheit.
 - .2 ft: foot/feet.
 - .3 ga: guage.
 - .4 gpm: gallons per minute.
 - .5 in: inches.
 - .6 lbs: pounds.
 - .7 NTU: nephelometric turbidity unit.
 - .8 psi: pounds-force per square inch.
 - .9 ppm: parts per million.

1.9 LEED TERMS

- .1 Acronyms specific to LEED:
 - .1 CI: commercial interiors.
 - .2 EQ: environmental quality.
 - .3 MR: material and resources.
 - .4 NC: new construction.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 DEFINITIONS

- .1 Mock-ups: Full size, physical example assemblies to illustrate finishes and materials. Mock-ups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not samples; mock-ups establish the standard by which the Work will be judged.

1.2 INSPECTION

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

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.4 ACCESS TO WORK

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

1.5 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
-

- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative may deduct from Contract Amount difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.7 REPORTS

- .1 Submit 4 copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

1.8 TESTS AND MIX DESIGNS

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

1.9 MOCK-UPS

- .1 Before installing portions of the Work requiring mock-ups, build mock-ups for each form of construction and finish required to comply with the requirements of this section, and any additional requirements listed in the technical sections, using materials indicated for the completed Work.
 - .2 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
 - .3 Construct in all locations acceptable to Departmental Representative and as specified in specific Section.
 - .4 Prepare mock-ups for Departmental Representative's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
 - .5 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
-

- .6 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.
- .7 Mock-ups may remain as part of Work.
- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .9 Required mock-ups are listed in the Technical Specification Sections (Divisions 02 through 49). Some mock-ups require several sections of work to cooperate and construct a complete assembly. Coordinate the activities of these sections to ensure that required mock-ups are completed.

1.10 MILL TESTS

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

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit testing, adjusting and balancing reports for mechanical, electrical and building equipment systems.
- .2 Submit Commissioning Documentation in accordance with Section 01 91 00.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

1.4 DEWATERING

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

1.5 WATER SUPPLY

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

1.6 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10°C in areas where construction is in progress.

- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, will not be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, restore to “new” condition.
- .8 Pay costs for maintaining temporary heat, when using permanent heating system.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.
- .3 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .5 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.8 TEMPORARY COMMUNICATION FACILITIES

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

1.9 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood., withdrawn.
 - .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel, withdrawn.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .3 CSA Z797-09, Code of practice for Access Scaffold.
 - .4 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CSA Z797.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

1.5 HOISTING

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

1.6 SITE STORAGE/LOADING

- .1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.
-

- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.7 CONSTRUCTION PARKING

- .1 Parking on site is restricted. Departmental Representative may allow limited use of parking if available. Contractor will make arrangements as required.
- .2 Provide and maintain adequate access to project site.
- .3 Clean construction roads and parking areas where used by Contractor's equipment.

1.8 OFFICES

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

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in a 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 a 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 such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.11 CONSTRUCTION SIGNAGE

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
 - .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
 - .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
-

- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .8 Dust control: adequate to ensure safe operation at all times.
- .9 Provide snow removal during period of Work.

1.13 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.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood, withdrawn.
 - .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel, withdrawn.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-O121-08 (R2013), Douglas Fir Plywood.

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 HOARDING

- .1 Erect temporary site enclosure using modular freestanding fencing: galvanized, minimum 1.8 m high, chain link or welded steel mesh, pipe rail. Provide one lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys. Maintain fence in good repair.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage of equipment and construction procedures.
- .3 Provide hoarding from temporary sally port gate to principal entrance as indicated.

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by governing authorities.

1.5 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.

1.6 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.
-

1.7 ACCESS TO SITE

- .1 Refer to Section 01 35 13.

1.8 PUBLIC TRAFFIC FLOW

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

1.9 FIRE ROUTES

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

1.10 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.11 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Within text of specifications, reference may be made to reference standards.
- .2 Conform to these standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 The cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

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

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
-

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

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

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

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

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

1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

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

1.12 PROTECTION OF WORK IN PROGRESS

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

1.13 EXISTING UTILITIES

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

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.
-

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

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

1.2 QUALIFICATIONS OF SURVEYOR

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

1.3 SURVEY REFERENCE POINTS

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

1.4 SURVEY REQUIREMENTS

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

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

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

- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.7 RECORDS

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

1.8 SUBMITTALS

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

1.9 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUBMITTALS

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

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00.

1.3 PREPARATION

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

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching to complete Work.
 - .2 Fit several parts together, to integrate with other Work.
 - .3 Uncover Work to install ill-timed Work.
-

- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00, full thickness of the construction element.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse, recycling, in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 PROJECT CLEANLINESS

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

1.2 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 other than that caused by Departmental Representative or other Contractors.
 - .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
 - .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
 - .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
-

- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 HEPA vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 CONSTRUCTION & DEMOLITION WASTE

- .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 60% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
- .2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
 - .1 Provide facilities for collection, handling and storage of source separated wastes.
 - .2 Source separate the following waste:
 - .1 Brick and portland cement concrete.
 - .2 Corrugated cardboard.
 - .3 Wood, not including painted or treated wood or laminated wood.
 - .4 Gypsum board, unpainted.
 - .5 Steel.
 - .6 Items indicated in Section 02 42 93, Deconstruction and Waste Products Workplan Summary.
- .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
 - .1 Indicate how material being removed from the site will be reused, recycled, composted or anaerobically digested using Section 02 42 93, Deconstruction and Waste Products Workplan Summary.
- .4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

1.2 WASTE PROCESSING SITES

- .1 Province of: Ontario.
 - .1 Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.
 - .2 Telephone: 800-565-4923 or 416-323-4321.
 - .3 Fax: 416-323-4682.
- .2 Recycling Council of Ontario: 215 Spadina Avenue, #225, Toronto, ON, M5T 2C7.
 - .1 Telephone: 416-657-2797
 - .2 Fax: 416-960-8053
 - .3 Email: rco@rco.on.ca.
 - .4 Internet: <http://www.rco.on.ca/>.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Government Chief Responsibility for the Environment:

Province	Address	General Inquiries	Fax
Ontario	Ministry of Environment and Energy 135 St. Clair Avenue West Toronto, ON M4V 1P5	(416) 323-4321 (800) 565-4923	(416) 323-4682
	Environment Canada Toronto, ON	(416) 734-4494	

END OF SECTION

Part 1 GENERAL

1.1 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative's Inspection.
- .2 Departmental Representative's Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by Fire Commissioner, Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.

1.2 CLEANING

- .1 In accordance with Section 01 74 11.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 As-built, samples, and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.
- .7 Final site survey.

1.2 SUBMISSION

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection, with Departmental Representative's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of maintenance manuals and commissioning documentation in English.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.3 FORMAT

- .1 Organize data in the form of an 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. 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. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.4 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission; names,
 - .2 addresses, and telephone numbers of 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 clearly 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. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
- .6 Training: Refer to Section 01 79 00.

1.5 AS-BUILTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Amendments and addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .2 Store record documents and samples in field office apart from documents used for construction. 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. Label each document "PROJECT RECORD" in neat, large, printed letters.
 - .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
 - .5 Keep record documents and samples available for inspection by Departmental Representative.
 - .6 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work. Submit files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.
-

- .7 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental Representative one set of drawings and specifications marked "AS-BUILT".

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly 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 Amendments and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.7 FINAL SURVEY

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

1.8 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
-

- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 and 01 91 00.
- .15 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 colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.10 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
-

1.11 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.12 SPECIAL TOOLS

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

1.13 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.14 WARRANTIES AND BONDS

- .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 the applicable item of work.
 - .4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Certificate of Substantial Performance is determined.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Co-execute submittals when required.
 - .7 Retain warranties and bonds until time specified for submittal.
-

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of substantial performance.
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.2 QUALITY CONTROL

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.
- .2 Submit training schedule of time and date for demonstration and training of each item of equipment and each system in accordance with the training plan four weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Report shall give time and date of each demonstration and training, with list of persons present.

1.3 CONDITIONS FOR DEMONSTRATIONS

- .1 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 00 and equipment and systems are fully operational.
- .2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.4 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated O&M personnel are present.

1.5 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 or designated location.
 - .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
 - .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.
-

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned; refer to Related Sections for specific commissioning requirements for individual systems and equipment.

1.2 RELATED REQUIREMENTS

- .1 Section 01 31 19 – Project Meetings
- .2 Section 01 77 00 – Closeout Procedures
- .3 Section 01 78 00 – Closeout Submittals

1.3 DEFINITIONS

- .1 BoD: Basis of Design.
- .2 CxA: Commissioning Authority.
- .3 DID: Design Intent Document which was prepared by the Departmental Representative during the early stages of the project to record quantifiable design values for systems and assemblies being commissioned, and which will be used to determine whether or not the building meets the Departmental Representative's expectations.
- .4 DRPR: Departmental Representative's Project Requirements.
- .5 SRC: Systems Readiness Checklist, checklist and Certificate of Readiness.
- .6 VTP: Verification Testing Procedures, checklists.
- .7 Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- .8 TAB: Testing, Adjusting, and Balancing.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinating Meetings: CxA is responsible to coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities in accordance with Section 01 31 19.
 - .2 Pre-testing Meetings: CxA is responsible to conduct pre-test meetings of the commissioning team to review Start-Up reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.
 - .3 Testing Coordination: CxA is responsible to coordinate sequence of testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting; schedule times for tests, inspections, obtaining samples, and similar activities.

- .4 Manufacturers' Site Services: CxA is responsible to coordinate services of manufacturers' site services.
- .2 Commissioning Team:
 - .1 Members Appointed by Departmental Representative:
 - .1 CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process; Departmental Representative will engage the CxA under a separate contract.
 - .2 Representatives of the facility user and operation and maintenance personnel
 - .3 Departmental Representative and engineering design professionals; forward copies of supplemental instructions, requests for information, change orders, construction meeting minutes, and other pertinent construction phase documentation to CxA for the purposes of keeping the CxA informed on current project status and to verify that integrity of DID is maintained.

1.5 SUBMITTALS

- .1 Commissioning Plan Pre-final Submittal:
 - .1 CxA is responsible to submit two (2) hard copies of pre-final commissioning plan.
 - .2 Deliver one copy to Contractor, and one to Departmental Representative.
 - .3 Present submittal in sufficient detail to evaluate data collection and arrangement process.
 - .4 One copy, with review comments, will be returned to the CxA for preparation of the final construction phase commissioning plan.
- .2 Commissioning Plan Final Submittal:
 - .1 CxA is responsible to submit two (2) hard copies and two sets of electronically formatted information of final commissioning plan.
 - .2 Deliver one hard copy and one set of discs to Departmental Representative.
 - .3 The final submittal must address previous review comments.
 - .4 The final submittal shall include a copy of the pre-final submittal review comments along with a response to each item.
- .3 Test Checklists and Report Forms:
 - .1 CxA is responsible to submit sample checklists and forms to Contractor for review and comment.
 - .2 Submit two (2) copies of each checklist and report form.
- .4 Certificates of Readiness: Contractor shall submit Certificates of Readiness to the CxA for review prior to the start of commissioning.
- .5 Test and Inspection Reports: CxA is responsible to submit test and inspection reports.
- .6 Corrective Action Documents: CxA is responsible to submit corrective action documents.
- .7 Pre-final Commissioning Report Submittal:
 - .1 CxA is responsible to submit two (2) hard copies of the pre-final commissioning report.

- .2 Include a copy of the preliminary submittal review comments along with CxA's response to each item.
- .3 CxA is responsible to deliver one copy to Departmental Representative.
- .4 One copy, with review comments, will be returned to the CxA for preparation of final submittal.
- .8 Final Commissioning Report Submittal:
 - .1 CxA is responsible to submit two (2) hard copies and two (2) sets of electronically formatted information of the final commissioning report.
 - .2 CxA is responsible to deliver one hard copy and one set of discs to Departmental Representative.
 - .3 The final submittal must address previous review comments and shall include a copy of the pre-final submittal review comments along with a response to each item.

1.6 QUALITY ASSURANCE

- .1 Instructor Qualifications: Factory authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- .2 Test Equipment Calibration:
 - .1 Comply with test equipment manufacturer's calibration procedures and intervals.
 - .2 Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping.
 - .3 Affix calibration tags to test instruments.
 - .4 Instruments shall have been calibrated within six months prior to use.

Part 2 Products

2.1 COMMISSIONING DOCUMENTATION

- .1 Index of Commissioning Documents: CxA is responsible to prepare an index to include storage location of each document.
- .2 DRPR: A written document, prepared by Departmental Representative that details the functional requirements of Project and expectations of how it will be used and operated; this document includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- .3 BoD Document: A document, prepared by Departmental Representative, that records concepts, calculations, decisions, and product selections used to meet the DRPR and to satisfy applicable regulatory requirements, standards, and guidelines; the document includes both narrative descriptions and lists of individual items that support the design process.

- .4 Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include; but is not limited to the following:
 - .1 Plan for delivery and review of submittals, systems manuals, and other documents and reports including:
 - .1 Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes
 - .2 Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan
 - .2 Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 - .3 Identification of systems and equipment to be commissioned
 - .4 Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
 - .5 Identification of items that must be completed before the next operation can proceed.
 - .6 Description of responsibilities of commissioning team members
 - .7 Description of observations to be made
 - .8 Description of requirements for operation and maintenance training, including required training materials
 - .9 Description of expected performance for systems, subsystems, equipment, and controls
 - .10 Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
 - .11 Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase
 - .12 Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
 - .13 Process and schedule for completing pre-start and Start-Up checklists for systems, subsystems, and equipment to be verified and tested.
 - .14 Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
- .5 Test Checklists: CxA shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested, and as follows:
 - .1 Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required.
 - .2 Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are contained in the referenced commissioning specification sections; each checklist, regardless of system, subsystem, or equipment being tested shall include the following:
 - .1 Name and identification code of tested item
 - .2 Test number

- .3 Time and date of test
 - .4 Indication of whether the record is for a first test or retest following correction of a problem or issue
 - .5 Dated signatures of the person performing test and of the witness, if applicable
 - .6 Individuals present for test
 - .7 Deficiencies
 - .8 Issue number, if any, generated as the result of test
- .6 Certificate of Readiness:
- .1 Certificate of Readiness shall be signed by Contractor and Installer(s), certifying that systems, subsystems, equipment, and associated controls are ready for testing and submit to the CxA for review prior to testing.
- .7 Test and Inspection Reports:
- .1 CxA is responsible to record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data.
 - .2 CxA is responsible to compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.
- .8 Corrective Action Documents:
- .1 CxA is responsible to document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any.
 - .2 Retest systems and equipment requiring corrective action and document retest results.
- .9 Issues Log:
- .1 CxA is responsible to prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the DRPR, BoD, and Contract Documents.
 - .2 Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.
 - .3 Creating an Issues Log Entry:
 - .1 Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
 - .2 Assign a descriptive title of the issue.
 - .3 Identify date and time of the issue.
 - .4 Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
 - .5 Identify system, subsystem, and equipment to which the issue applies.
 - .6 Identify location of system, subsystem, and equipment.
 - .7 Include information that may be helpful in diagnosing or evaluating the issue.
 - .8 Note recommended corrective action.
 - .9 Identify commissioning team member responsible for corrective action.
 - .10 Identify expected date of correction.

- .11 Identify person documenting the issue.
- .4 Documenting Issue Resolution:
 - .1 Log date correction is completed or the issue is resolved.
 - .2 Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
 - .3 Identify changes to the DRPR, BoD, or Contract Documents that may require action.
 - .4 State that correction was completed and system, subsystem, or piece of equipment is ready for retest, if applicable.
 - .5 Identify person(s) who corrected or resolved the issue.
 - .6 Identify person(s) documenting the issue resolution.
- .5 Issues Log Report:
 - .1 On a periodic basis; but not less than for each commissioning team meeting, CxA is responsible to prepare a written narrative for review of outstanding issues and a status update of the issues log.
 - .2 As a minimum, CxA is responsible to include the following information in the issues log and expand it in the narrative:
 - .1 Issue number and title.
 - .2 Date of the identification of the issue.
 - .3 Name of the commissioning team member assigned responsibility for resolution.
 - .4 Expected date of correction.
- .10 Commissioning Report:
 - .1 CxA is responsible to document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment.
 - .2 Commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the DRPR, BoD, and Contract Documents.
 - .3 Commissioning report shall include; but is not limited to, the following:
 - .1 Lists and explanations of substitutions; compromises; variances in the DRPR, BoD, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution:
 - .1 This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Departmental Representative occupancy and operation.
 - .2 It shall describe components and performance that exceed requirements of the DRPR, BoD, and Contract Documents and those that do not meet requirements of the DRPR, BoD, and Contract Documents.
 - .3 It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
 - .2 DRPR and BoD documentation
 - .3 Commissioning plan
 - .4 Testing plans and reports
 - .5 Corrective modification documentation

- .6 Issues log
- .7 Completed test checklists
- .8 Listing of off-season test(s) not performed and a schedule for their completion

2.2 ENHANCED COMMISSIONING SYSTEMS MANUAL

- .1 Systems Manual: CxA is responsible to gather required information and compile systems manual. Systems manual shall include; but is not limited to, the following:
 - .1 Final version of the BoD
 - .2 System single-line diagrams
 - .3 As-built sequences of operations, control drawings, and original set points
 - .4 Operating instructions for integrated building systems
 - .5 Recommended schedule of maintenance requirements and frequency, if not already included in the project O&M manuals
 - .6 Recommended schedule for retesting of commissioned systems with blank test forms from the original commissioning plan.
 - .7 Recommended schedule for calibrating sensors and actuators.

Part 3 Execution

3.1 RESPONSIBILITIES

- .1 Departmental Representative's Responsibilities: Provide the DRPR documentation to the CxA and Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists and as follows:
 - .1 Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including; but not limited to, the following:
 - .1 Coordination meetings
 - .2 Training in operation and maintenance of systems, subsystems, and equipment
 - .3 Testing meetings
 - .4 Demonstration of operation of systems, subsystems, and equipment
 - .2 Provide the BoD documents prepared by Consultant and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, and systems manual.
- .2 Contractor's Responsibilities: Provide utility services required for the commissioning process and as follows:
 - .1 Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including; but not limited to, the following:
 - .1 Participate in construction phase coordination meetings.
 - .2 Participate in maintenance orientation and inspection.
 - .3 Facilitate operation and maintenance training sessions, organize location and schedule, and develop training program.
 - .4 Participate in final review at acceptance meeting.

- .5 Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
- .6 Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
- .7 Review and approve final commissioning documentation.
- .8 Develop commissioning schedule in conjunction with CxA based on commissioning scope; coordinate with construction schedule and update prior to each commissioning meeting.
 - .1 Videotape and edit training sessions.
- .2 Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including; but not limited to, the following:
 - .1 Participate in construction phase coordination meetings.
 - .2 Participate in maintenance orientation and inspection.
 - .3 Participate in procedures meeting for testing.
 - .4 Participate in final review at acceptance meeting.
 - .5 Provide schedule for operation and maintenance data submittals, equipment Start-Up, and testing to CxA for incorporation into the commissioning plan.
 - .6 Provide input to update commissioning schedule prior to each commissioning meeting.
 - .7 Provide information to the CxA for developing construction phase commissioning plan.
 - .8 Provide operation and maintenance training on installed systems, organize required instructors and manufacturer's representatives, and schedule training sessions.
 - .9 Submit an operation and maintenance data manual to the CxA prior to commissioning, as specified in Section 01 78 00; Manual may be in draft form to facilitate Commissioning Schedule.
 - .10 Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.
- .3 CxA's Responsibilities: Organize and lead the commissioning team and as follows:
 - .1 Prepare a construction phase commissioning plan.
 - .2 Collaborate with Contractor and with Subcontractors to develop test and inspection procedures:
 - .1 Include design changes and assist with development of commissioning activities schedule coordinated with overall Project schedule.
 - .2 Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.
 - .3 Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the DRPR and BoD.

- .4 Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes in accordance with requirements listed in Section 01 31 19:
 - .1 Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants.
 - .2 The CxA is responsible to prepare and distribute minutes to commissioning team members and attendees within five (5) workdays of the commissioning meeting.
 - .5 At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.
 - .6 Review and verify approved shop drawing submittals.
 - .7 Review the draft and final Testing and Balancing reports.
 - .8 Inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair in addition to compliance with the DRPR, BoD, SRC, VTP and Contract Documents; submit Issues Log Report based on these inspections.
 - .9 Prepare project specific test and inspection procedures and checklists.
 - .10 Witness, and document tests, inspections, and systems Start-Up.
 - .11 Compile test data, inspection reports, and certificates and include them in the commissioning report.
 - .12 Certify date of acceptance and Start-Up for each item of equipment for start of warranty periods.
 - .13 Review control documentation shop drawings including:
 - .1 System Schematics
 - .2 Point List and Descriptions
 - .3 Sequences of Operation
 - .14 Review and comment on operation and maintenance documentation for compliance with the DRPR, BoD, and Contract Documents; operation and maintenance documentation requirements are specified in Section 01 78 00.
 - .15 Prepare commissioning reports.
 - .16 Assemble the final commissioning documentation, including the commissioning report.
- .4 CxA's Responsibilities – Enhanced Commissioning:
- .1 Review and comment on submittals from Contractor for compliance with the DRPR, BoD, Contract Documents, and construction phase commissioning plan.
 - .2 Assemble the Systems Manual for submission to the Departmental Representative.

3.2 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- .1 Training Preparation Conference:
 - .1 Before operation and maintenance training, CxA is responsible to convene a training preparation conference to include Departmental Representative's operation and maintenance personnel, and Contractor.

- .2 In addition to requirements specified in Section 01 79 00, perform the following:
 - .1 Review the DRPR and BoD.
 - .2 Review installed systems, subsystems, and equipment.
 - .3 Review instructor qualifications.
 - .4 Review instructional methods and procedures.
 - .5 Review training module outlines and contents.
 - .6 Review course materials (including operation and maintenance manuals).
 - .7 Review and discuss locations and other facilities required for instruction.
 - .8 Review training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 - .9 Coordinate Systems Training provided by Contractor.

3.3 VERIFICATION TESTING

- .1 CxA will coordinate, conduct, and witness all system verification tests to verify that the systems operate in accordance with the design intent; Contractor shall be responsible for performing the verification tests and operating the systems during commissioning.
- .2 Any system deficiencies discovered during verification testing will be documented and logged by the CxA and identified for corrective action; retesting specific systems or system components will take place once the respective deficiencies discovered during the first test are resolved.
- .3 Coordinate with requirements of individual Technical Specification Sections for detailed requirements relating to verification testing.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or materials that endanger human health or environment if handled improperly.
 - .2 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as co-ordinating related, required submittal and reporting requirements.
 - .3 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill.
 - .4 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.
- .2 Reference Standards:
 - .1 Canadian Environmental Protection Act (CEPA)
 - .1 CCME PN 1326-2008, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
 - .2 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
 - .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
 - .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S660-08, Standard for Nonmetallic Underground Piping for Flammable and Combustible Liquids.
 - .2 ULC/ORD-C58.15-1992, Overfill Protection Devices for Flammable Liquid Storage Tanks.
 - .3 ULC/ORD-C58.19-1992, Spill Containment Devices for Underground Flammable Liquid Storage Tanks.

- .5 U.S. Environmental Protection Agency (EPA)
 - .1 EPA CFR 86.098-10, Emission standards for 1998 and later model year Otto-cycle heavy-duty engines and vehicles.
 - .2 EPA CFR 86.098-11, Emission standards for 1998 and later model year diesel heavy-duty engines and vehicles.
 - .3 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor's Representative and Departmental Representative in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Verify existing site conditions adjacent to demolition work.
 - .3 Co-ordination with other construction subtrades.
 - .2 Hold project meetings in accordance with Section 01 31 19.
 - .3 Ensure site supervisor, subcontractor representatives and WMC attend.
 - .4 WMC must provide written report on status of waste diversion activity at each meeting.
 - .5 Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.
- .2 Scheduling:
 - .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
 - .1 In event of unforeseen delay notify Departmental Representative in writing.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Sections 01 33 00 and Section 01 74 20.
- .2 WMC is responsible for fulfillment of reporting requirements.
- .3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 20 and indicate:
 - .1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.
 - .2 Schedule of selective demolition.
 - .3 Number and location of dumpsters.
 - .4 Anticipated frequency of tippage.
 - .5 Name and address of haulers, waste facilities and waste receiving organizations.

- .4 Submit copies of certified weigh bills from authorized disposal sites and reuse and recycling facilities for material removed from site on a weekly basis upon request of Departmental Representative.
 - .1 Written authorization from Departmental Representative is required to deviate from haulers listed in Waste Reduction Workplan.
- .5 Shop Drawings:
 - .1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.
 - .2 Submit demolition drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: Ensure Work is performed in compliance with CEPA, CEAA, TDGA and applicable Provincial/Territorial and Municipal regulations.

1.5 SITE CONDITIONS

- .1 Environmental protection:
 - .1 Ensure Work is done in accordance with Section 01 35 43.
 - .2 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .3 Fires and burning of waste or materials is not permitted on site.
 - .4 Do not bury rubbish waste materials.
 - .5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .6 Ensure proper disposal procedures are maintained throughout project.
 - .7 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
 - .8 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction and as directed by Departmental Representative.
 - .9 Protect trees, plants and foliage on site and adjacent properties where indicated.
 - .10 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
 - .11 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

1.6 EXISTING CONDITIONS

- .1 If material resembling spray or trowel applied asbestos or other designated substance be encountered in course of demolition, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions have been received from Departmental Representative.
 - .2 Structures to be demolished are based on their condition on date that bid is accepted.
-

- .1 Remove, protect and store salvaged items as directed by Departmental Representative. Salvage items as identified by Departmental Representative. Deliver to Departmental Representative as directed.

Part 2 PRODUCTS

2.1 NOT USED

Part 3 EXECUTION

3.1 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Work in accordance with Section 01 35 43.
 - .2 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, landscaping, parts of existing building to remain.
 - .1 Provide bracing, shoring as required.
 - .2 Repair damage caused by demolition as directed by Departmental Representative.
 - .3 Support affected structures and, if safety of structure being demolished or adjacent structures appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.
 - .4 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
- .2 Surface Preparation:
 - .1 Do not disrupt active or energized utilities designated to remain undisturbed.
 - .2 Remove rodent and vermin as required by Departmental Representative.

3.2 DEMOLITION

- .1 Do demolition work in accordance with Section 01 56 00.
 - .2 Blasting operations not permitted during demolition.
 - .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
 - .4 To permit construction of addition.
 - .5 Crush concrete generated due to demolition of foundations to size suitable for recycling.
 - .6 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
 - .7 At end of each day's work, leave Work in safe and stable condition.
 - .8 Demolish to minimize dusting. Keep materials wetted as directed by Departmental Representative.
 - .9 Remove structural framing.
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- .10 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.
- .11 Only dispose of material specified by selected alternative disposal option as directed by Departmental Representative.
- .12 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .13 Use natural lighting to do Work where possible.
 - .1 Shut off lighting except those required for security purposes at end of each day.

3.3 CLEANING

- .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert excess materials from landfill to site approved Departmental Representative.
 - .3 Designate appropriate security resources / measures to prevent vandalism, damage and theft.
 - .4 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.
 - .1 Label stockpiles, indicating material type and quantity.
 - .5 Separate from general waste stream each of following materials. Stockpile materials in neat and orderly fashion in location and as directed by Departmental Representative for alternate disposal. Stockpile materials in accordance with applicable fire and safety regulations.
 - .1 Glass fibre ceiling tiles.
 - .2 Wood fibre ceiling tiles.
 - .3 Power source poles deemed unfit for reuse by Departmental Representative.
 - .4 Wiring and conduit.
 - .5 Outlets/switches.
 - .6 Floor receptacles.
 - .7 Metal duct work, baffles, HVAC equipment.
 - .8 Demountable partitions.
 - .9 Drapes.
 - .10 Tracks and blinds.
 - .11 Insulation batts.
 - .12 Miscellaneous metals.
 - .13 Carpet.
 - .6 Supply separate, clearly marked disposal bins for categories of waste material. Please notify Departmental Representative prior to removal of bins from site.
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- .7 Remove stockpiled material as directed by Departmental Representative, when it interferes with operations of project construction.
- .8 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .9 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of.
 - .2 Written authorization from Departmental Representative is required to deviate from disposal facilities.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA):
 - .1 CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .2 CAN/CSA-O86-09, Engineering Design in Wood.
 - .3 CAN/CSA-O86.1S1-98, Supplement No. 1 to CAN/CSA-O86-09, Engineering Design in Wood (Limit States Design).
 - .4 CSA O121-08, Douglas Fir Plywood.
 - .5 CSA O151-09, Canadian Softwood Plywood.
 - .6 CSA O153-13, Poplar Plywood.
 - .7 CAN3-O188.0-M78, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.
 - .8 CSA O437 Series-93(R2011), Standards for OSB and Waferboard.
 - .9 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
 - .10 CAN/CSA-S269.3-M92(R2008), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI):
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-O86.1.
 - .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.

- .2 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form liner:
 - .1 Plywood: Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151 exterior grade, T and G, 20 mm thick, urea formaldehyde free.
 - .2 Waferboard: to CAN3-O188.0, exterior grade, 20 mm thick.
- .4 Form release agent: non-toxic, biodegradable, low VOC.
- .5 Falsework materials: to CSA-S269.1.
- .6 Sealant: to Section 07 90 00.

Part 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA-S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .11 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

- .13 Construct forms for architectural concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .15 Clean formwork in accordance with CSA-A23.1/ A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 3 days for walls and sides of beams.
 - .2 3 days for columns.
 - .3 1 day for footings and abutments.
- .2 Remove formwork when concrete has reached 50% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Concrete Institute (ACI):
 - .1 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
 - .2 ACI SP-66-04, ACI Detailing Manual.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .4 ASTM A496/A496M-07, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - .5 ASTM A497/A497M-07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
- .3 Canadian Standards Association (CSA):
 - .1 CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .2 CAN/CSA-A23.3-04(R2010), Design of Concrete Structures for Buildings.
 - .3 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CAN/CSA-G40.20-04/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steels.
 - .5 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 33 00.
 - .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada. ACI SP-66, ACI Detailing Manual.
 - .3 Detail lap lengths and bar development lengths to CAN/CSA-A23.3.
-

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A496/A496M.
- .6 Welded steel wire fabric: to ASTM A185/A185M. Provide in flat sheets only chaired into position as indicated on the drawings.
- .7 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .8 Mechanical splices: subject to approval of Departmental Representative.
- .9 Plain round bars: to CAN/CSA-G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ACI SP-66, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.
- .2 Upon request, inform Departmental Representative of proposed source of material to be supplied.

Part 3 EXECUTION

3.1 FIELD BENDING

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

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA-A23.1/A23.2.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.

3.3 FIELD TOUCH-UP

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International:
 - .1 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
- .3 CSA International:
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A3000-08, Cementitious Materials Compendium consists of A3001, A3002, A3003, A3004 and A3005.
 - .3 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 31 19, convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel, Departmental Representative, speciality contractor - finishing, forming attend.
 - .2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 Shop Drawings:
 - .1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.
 - .2 Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.
 - .3 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .3 At least 4 weeks prior to beginning Work, inform Departmental Representative of source of fly ash.
 - .1 Do not change source of fly ash without written approval of Departmental Representative.
 - .4 At least 4 weeks prior to beginning Work, submit to Departmental Representative samples of following materials proposed for use: curing compound, joint fillers and waterstops.
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- .5 Submit samples of materials to be used in concrete mix for testing as follows:
 - .1 1 kg Supplementary cementing materials.
 - .2 1 kg blended hydraulic cement.
 - .3 1 kg admixture.
 - .4 Fine and coarse aggregate.
 - .5 1 kg fly ash.
- .6 Provide testing and inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .7 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 QUALITY ASSURANCE

- .1 Provide to Departmental Representative, 4 weeks minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
 - .1 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Cement: to CSA A3001, Type GUL.
 - .2 Blended hydraulic cement: Type GULb to CSA A3001.
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- .3 Supplementary cementing materials: with minimum 20% Type F fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .4 Water: to CSA A23.1/A23.2.
- .5 Reinforcing bars: to CAN/CSA-G30.18, Grade 400.
- .6 Welded steel wire fabric: to ASTM A185, flat sheets only.
- .7 Premoulded joint filler:
 - .1 Bituminous impregnated fibreboard: to ASTM D1751.
- .8 Joint sealer/filler: grey to CAN/CGSB-19.24, Type 1, Class B.
- .9 Sealer: boiled linseed oil to ASTM D260, mixed with mineral spirits 1:1.
- .10 Other concrete materials: to CSA A23.1/A23.2.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Provide Departmental Representative 24 hours notice before each concrete pour.
- .2 Place concrete reinforcing in accordance with Section 03 20 00.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of rehandling, and without damage to existing structure or Work.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application of concrete finishes.

3.2 INSTALLATION/ APPLICATION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required to be built-in.
 - .2 Sleeves and openings greater than 100 mm x 100 mm not indicated, must be reviewed by Departmental Representative.

3.3 FINISHES

- .1 Formed surfaces exposed to view: sack rubbed finish in accordance with CSA A23.1/A23.2.
- .2 Interior floor slabs to be left exposed to receive sheet vinyl requiring smooth surface: initial finishing operations followed by final finishing comprising mechanical floating and steel trowelling as specified in CSA A23.1/A23.2 to produce hard, smooth, dense trowelled surface free from blemishes.

- .3 Floor slabs to receive mortar bed for ceramic or quarry tile: screed to correct grade to provide broomed texture.
- .4 Equipment pads: provide smooth trowelled surface.
- .5 Pavements, walks, curbs and exposed site concrete:
 - .1 Screed to plane surfaces and use wood floats.
 - .2 Provide round edges and joint spacings using standard tools.
 - .3 Trowel smooth to provide lightly brushed non-slip finish.

3.4 CONTROL JOINTS

- .1 Cut control joints in slabs on grade at locations indicated, to CSA A23.1/A23.2 and install specified joint sealer/filler.

3.5 EXPANSION AND ISOLATION JOINTS

- .1 Install premoulded joint filler in expansion and isolation joints full depth of slab flush with finished surface to CSA A23.1/A23.2.

3.6 CURING

- .1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.7 SEALING APPLICATION

- .1 After curing is complete, apply two even coats of linseed oil mixture to clean dry surfaces, each at 8 m² /L. Allow first coat to dry before applying second coat.

3.8 SITE TOLERANCES

- .1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

3.9 FIELD QUALITY CONTROL

- .1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Departmental Representative in accordance with Section 01 29 83.

3.10 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate cleaning area for tools to limit water use and runoff.
- .4 Cleaning of concrete equipment to be done in accordance with Section 01 35 43.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 CSA International:
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1168-A2005(June 2006), Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.
 - .2 Include application instructions for concrete floor treatments.

1.3 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
 - .1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:
 - .1 Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

- .5 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Ventilate enclosed spaces in accordance with Section 01 51 00.
 - .3 Provide continuous ventilation during and after coating application.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

2.2 CHEMICAL HARDENERS

- .1 Type 1 - Sodium silicate.
- .2 Water: potable.

2.3 SEALING COMPOUNDS

- .1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based clear.
- .2 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .3 Surface sealer: acrylic carnuba wax.

2.4 CURING COMPOUNDS

- .1 Select low VOC, water-based, organic-solvent free curing compounds.

2.5 CONCRETE STAINS

- .1 Select low VOC, water-based concrete stains.

2.6 MIXES

- .1 Mixing ratios in accordance with manufacturer's written instructions.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that slab and substrate surfaces are ready to receive work and elevations are as indicated and as recommended by manufacturer's written instructions.

3.2 PREPARATION OF EXISTING SLAB

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.
- .2 Saw cut control joints to CSA A23.1/A23.2, 24 hours maximum after placing of concrete.
- .3 Use strong solvent or mechanical stripping to remove chlorinated rubber or existing surface coatings.
- .4 Use protective clothing, eye protection and respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

3.3 APPLICATION

- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
- .2 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .4 Clean over spray. Clean sealant from adjacent surfaces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.5 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for concrete floor hardeners, slip resistant coatings, and sheet curing materials.

1.2 REFERENCES

- .1 Health Canada - Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include application instructions for concrete hardener curing compound and slip resistant coating.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets.
 - .1 WHMIS MSDS acceptable to Human Resources Development Canada-Labour and Health Canada for concrete floor hardeners.
 - .2 Indicate VOC content.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .2 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m² of floor being finished.
 - .2 Electrical power:
 - .1 Sufficient electrical power to operate equipment normally used during construction.
 - .3 Work area:
 - .1 Water tight protection against rain and detrimental weather conditions.
 - .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10°C from 7 days before installation to at least 48 hours after completion of Work and maintain relative humidity not higher than 40% during same period.
 - .2 Maintain substrate temperature at 10°C minimum.
 - .5 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
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- .6 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Ventilate enclosed spaces in accordance with Section 01 51 00.
 - .3 Provide continuous ventilation during and after coating application.

Part 2 PRODUCTS

2.1 SLIP RESISTANT ABRASIVE AGGREGATE

- .1 Emery aggregate: crushed emery, minimum 50% aluminum oxide.
- .2 Homogeneous aluminum oxide, minimum 95%.
- .3 Ferric oxide, minimum 25%.
- .4 Silicon carbide.

2.2 COLOURING AGENT

- .1 Non-metallic type cement colouring agent, colour selected by Departmental Representative.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that slab and substrate surfaces are ready to receive Work.

3.2 HARDENING

- .1 Apply slip resistant coating on floor surfaces as scheduled. Apply in strict accordance with manufacturer's written instructions.

3.3 PROTECTION

- .1 Protect finished installation until floor treatment has completely cured.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Polished Concrete Flooring: Mechanical grinding and polishing treatment applied to chemically densified and hardened concrete required to achieve specified sheen level using dry polishing methods to the greatest extent possible; wet polishing will not be permitted.
- .2 Aggregate Exposure Class: Depth of grind to achieve required appearance as follows:
 - .1 Cream: Minimal surface cut with little or no aggregate exposure.
 - .2 Fine Aggregate: 1.5 mm surface cut with salt and pepper appearance arising from fine aggregate exposure with little or no medium aggregate exposure and random locations.
 - .3 Medium Aggregate: 3 mm surface cut with predominately medium aggregate showing, some fine aggregate, and little or no large aggregate exposure at random locations.
 - .4 Large Aggregate: 6 mm surface cut with predominately large aggregate showing and little or no fine aggregate at random locations.
- .3 Reflective Clarity and Sheen: Amount of clarity when viewed from 1500 mm above and perpendicular to surface when viewing reflection of overhead objects; and reflective sheen when viewed at 6 metres from and at an angle to a surface and the degree of gloss reflected from that surface; and as follows:
 - .1 Ground: Flat appearance with no to very slight diffused reflection clarity and having no or very low reflective sheen.
 - .2 Honed: Matte appearance with slight diffused reflection clarity and having a low to medium reflective sheen.
 - .3 Semi-Polished: Soft or muted reflection clarity with reflected objects being identifiable and having a medium to high reflective sheen.
 - .4 Highly-Polished: Sharp and crisp reflection clarity and having a high to very high, mirror like sheen.

1.2 REFERENCE STANDARDS

- .1 Concrete Polishing Association of America (CPAA):
 - .1 Bonded Abrasive Polished Concrete Definitions

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Section 03 30 00 for wet curing methods and that any liquid curing compounds; whether specified or not, and that may have been applied to concrete slabs is fully removed before starting work of this Section.
- .2 Preconstruction Meeting: Arrange a preconstruction meeting in accordance with Section 01 31 19 – Project Meetings including Departmental Representative, Contractor, Subcontractor for work of this Section and other components of the work to discuss effects and issues governing installation of polished concrete floor finishes including protection of concrete surfaces from marking pens, cutting oils and other deleterious materials that could damage the final finish.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each grinding and polishing machine; include information on types of grinding heads, dust extraction, water control and concrete densifier materials.
 - .2 Samples: Submit minimum 300 mm x 300 mm sample concrete finish specified in this section.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written cleaning and maintenance instructions for applied finishes and instruct Owner in proper care and maintenance of specified floor finishes; include a complete list of floor care products that will be required for ongoing maintenance and name of original installer and contact information in accordance with Section 01 78 23.

1.6 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Installers: Use skilled workmen experienced in concrete finishing methods similar in complexity and extent to that required for the Work of the Contract.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to prevent damage to containers or bags, or damage from freezing or over heating; store materials in a clean, dry, heated location until ready for use.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Install when area is clean and ready for finishing operations; having sufficient water, temporary heat and light, and adequate power and outlets for operation of floor grinding and polishing equipment and temperature is within manufacturers recommended range.

Part 2 Products

2.1 MATERIALS

- .1 Concrete Polishing and Grinding Heads: Sized for machinery required for project; hand held and walk behind machinery as required for project requirements and specified gloss levels.
 - .2 Liquid Applied Floor Hardener Materials (Concrete Densifier): Water based, sodium silicate type, chemically reactive, permanent treatment, penetrating sealer and hardener; non-toxic, non-flammable, surface densification and anti-dusting treatment having less than 0 g/L VOC.
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- .3 Saw Cut Joint Filler: Self levelling, 100% solids, two component rapid curing polyurea elastomer joint filler formulated to withstand 10 to 15% change in joint width with primer, joint backing and bond break materials, accessories and equipment required for a complete installation; meeting maximum VOC content limits stated above.
- .4 Patching Compound and Grout: Manufacturer's recommended compatible cementitious/limestone/vinyl-acetate patching compound or clear epoxy-polyurethane resin grout; coloured and textured with grind material to match adjacent polished concrete surfaces; and forming a tenacious bond to concrete.
- .5 Equipment: Manufacturer's recommended equipment with dust extraction system including the following:
 - .1 Field Area Grinding and Polishing: Walk-behind machines having sufficient down pressure weight to achieve specified levels of finish.
 - .2 Edge and Detailing Area Grinding and Polishing: Hand held or walk behind machines capable of providing same finish as field area grinding and polishing equipment.
 - .3 Polishing and Grinding Pads: Diamond embedded grinding pads of varying grits, compatible with grinding and polishing equipment to achieve specified levels of finish.
 - .4 Burnishing Equipment: High speed walk-behind or ride-on machines; having sufficient down pressure weight and revolutions to heat floor surface; with high speed burnishing pads compatible with equipment and as required to achieve specified levels of gloss.
 - .5 Other Equipment: Provide additional equipment as required to complete polished concrete flooring installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Start work only when all defects have been corrected.

3.2 PREPARATION

- .1 Protect floor areas identified for polished concrete finishes from other trades, communicate to other trades that marking pens, cutting oils or contact from other substances deleterious to final finish will not be permitted.
 - .2 Verify that floor surface is free from materials that could affect chemical hardening and polishing process; and that concrete is sufficiently cured to permit chemical hardening reaction.
 - .3 Protect adjacent surfaces not designated to receive treatment; confirm that specified treatments can penetrate concrete surfaces.
 - .4 Fill saw cut control joints with manufacturer recommended joint filler to prevent spalling and chipping of joint edges.
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3.3 INSTALLATION

- .1 Concrete Densifier: Apply liquid floor densifier to surfaces in accordance with manufacturer's written instructions after initial floating; cure concrete in accordance with manufacturer's recommended procedures for a minimum of 28 days until sufficient free lime is available to activate the chemical hardening process and as follows:
 - .1 Apply densifier at rate recommended by manufacturer.
 - .2 Do not dilute except as specifically stated by manufacturer.
 - .3 Squeegee puddles as they occur.
- .2 Floor Grinding and Polishing: Grind and polish concrete using progressively finer diamond polishing pads as required to achieve Fine Aggregate Exposure Class, and Honed Sheen, and as follows:
 - .1 Fill joints and cracks, surface voids, and pits arising from loss of aggregate that become apparent during the grinding operations in accordance with manufacturer's instructions before final grinding stage.
 - .2 Grind and polish concrete floors using only dry counter rotating, vacuum shrouded walk behind machines to the greatest extent possible; finish areas inaccessible to walk behind machines with hand held grinders and polishers to match the appearance of the field areas.
 - .3 Vacuum and squeegee floors after each grinding step.
 - .4 Remove construction debris on an ongoing basis
 - .5 Clean floor thoroughly using clean water and auto-scrubber with wet vacuum attachment.
- .3 Patching Polished Concrete: Conserve grinding debris from each area for use as a component in patching materials and as follows:
 - .1 Mix grinding debris with patching compound to achieve colouration and surface appearance similar to adjacent surfaces.
 - .2 Patch tear outs and edge spalling using manufacturer's patching compound compatible with concrete polishing materials and methods.
 - .3 Select patching compound or grout based on extent and depth of patches and repairs required to prepare floor surfaces ready for finishing.
 - .4 Patch as work progresses and polish to match adjacent finished surfaces.

3.4 PROJECT CLOSEOUT

- .1 Protection: Cover polished concrete flooring after completion with protective coverings to protect finished surfaces for activities arising from subsequent construction.
- .2 Demonstration: Train Owner's designated maintenance personnel in the care and upkeep of polished and slip resistant concrete finishes, based on written maintenance instructions provided in accordance with Section 01 77 00.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CCMPA Canadian Concrete Masonry Producers Association Metric Technical Manual, September 2012.
- .2 ASTM International:
 - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM F593-02(2008)e1, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-37.4-M89, Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing (Withdrawn).
- .4 CSA International:
 - .1 CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .2 CAN/CSA-A165 Series-04(R2009) (CAN3-A165.1 Concrete Masonry Units) (CAN3-A165.2 Concrete Brick Units) (CAN3-A165.3 Prefaced Concrete Masonry Units Units).
 - .3 CSA A179-04(R2009), Mortar and Grout for Unit Masonry.
 - .4 CAN/CSA-A370-04(R2009), Connectors for Masonry.
 - .5 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
 - .6 CAN/CSA-A3000-08, Cementitious Materials Compendium consists of A3001, A3002, A3003, A3004 and A3005.
 - .7 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .8 CSA-S304.1-04(R2010), Design of Masonry Structures.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.
- .2 Submit samples of masonry anchors, and ties.
- .3 Submit shop drawings indicating wall sections and details, reinforcing and anchors, special detailing, patterning and locations of control joints.

1.3 QUALITY ASSURANCE

- .1 Provide plain and reinforced masonry in accordance with CSA A370, CSA A371, and CSA S304.1.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle masonry units in accordance with Section 01 61 00.
- .2 Remove unacceptable materials from Site and replace to acceptance of the Departmental Representative. Store materials off ground protected from wetting by rain, snow or ground water, or inter-mixture with earth or other materials. Store metal ties and reinforcement to prevent corrosion.
- .3 Do not concentrate storage of materials on any part of structure beyond design load, take particular care not to overload unsupported portions of structure which may have not attained their full design strength.
- .4 Comply with CSA A371. Do not use salt or calcium-chloride to remove ice from masonry surfaces.
- .5 Deliver mortar materials in original unbroken and undamaged packages with the maker's name and brand distinctly marked thereon. Prevent damage to units.
- .6 Keep masonry materials free from ice and frost. Keep units protected from concrete, mortar and other materials which could cause staining.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete block to CAN/CSA-A165.1: CCMPA Metric Size Codes sizes as indicated on Contract Drawings.
 - .1 H/15/A/M, hollow, normal weight for partitions.
 - .2 SF/15/A/M, full solid, normal weight for top course of load bearing walls.
 - .3 Special shapes: provide bullnosed units for exposed corners. Provide purpose-made shapes for lintels and bond beams. Provide additional special shapes as indicated.
 - .2 Mortar: to CSA A179, Proportion specification. Select type from table below.
 - .1 Exterior above grade:
 - .1 Type S: load bearing walls requiring high compressive strength.
 - .2 Type N: Non-load bearing walls, parapet walls.
 - .2 Interior:
 - .1 Type N: load bearing walls and non- load bearing partitions.
 - .2 Fine grout to Table 3.
 - .3 Connectors: to CAN/CSA-A370 and CSA S304.1, minimum Level 2 corrosion protection.
 - .4 Reinforcement: to CSA-A371,
 - .1 Truss type, galvanized steel wire to ASTM A82/A82M for single wythe masonry walls.
 - .5 Insulation retaining wedges: pvc, U shape wedge, rib face locking system.
 - .6 Reinforcing bars: to CSA-G30.18, Grade 400, deformed.
 - .7 SS bolts, nuts and washers: stainless steel to ASTM F593.
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- .8 Masonry flashing: 600 g/m² copper laminated to fibre reinforced, asphalt impregnated paper.
- .9 Masonry flashing adhesive: fibrated cutback asphalt to CAN/CGSB-37.4.
- .10 Metal flashings: Flashings in accordance with Section 07 62 00, continuous strips with a 19 mm folded drip edge.
- .11 Concrete aggregate: to CAN/CSA-A23.1/A23.2, 10 mm maximum size.
- .12 Fibre firestopping: bearing ULC label, mineral fibre material capable of being compressed into space at top of masonry partitions.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept work of this Section.

3.2 MIXING AND APPROVAL

- .1 In accordance CSA A179.
- .2 Do not commence masonry work until mortar is tested and approved by Departmental Representative.
- .3 Concrete mix shall attain:
 - .1 25 MPa compressive strength at 28 days.
 - .2 100 mm slump at time of deposit.

3.3 PROTECTION

- .1 Protect in accordance with CSA-A371, except following requirements supplement Clause 6.7.2:
 - .1 Maintain temperature of mortar between 5°C and 50°C until used.
- .2 Protect adjacent finished materials from damage due to masonry work.

3.4 INSTALLATION AND WORKMANSHIP

- .1 Perform masonry Work in accordance with CSA A371 and as indicated.
 - .2 Joints of uniform thickness. Tolerances suggested in notes to Clause 7.1 of CSA-A371 apply.
 - .3 Align vertical joints.
 - .4 Lay maximum 1800 mm height of masonry per day.
 - .5 Cut masonry with power saw.
 - .6 Fill space between top of non-bearing partitions, underside of deck and underside of structural members with fibre firestopping compressed as recommended by Manufacturer and requirements of ULC tests. Neatly trim on each side of partitions. Obtain lateral support angles from Section 05 50 00 and install at required spacing.
 - .7 Install mineral fibre joint filler between:
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- .1 Masonry and lintels.
- .8 Do masonry reinforcing, tying and connecting in accordance with CAN/CSA-A370 and CAN/CSA-A371. If there is conflict in the requirements of these two standards, the more stringent requirement shall apply.
- .9 Reinforce block walls with continuous wire reinforcement in every second block course. Supply and install prefabricated L and T sections. Cut, bend and lap reinforcing units as per manufacturer's printed directions for continuity at returns, offsets, pipe enclosures, and other special conditions. Bending of masonry reinforcement is not permitted.
- .10 Reinforce masonry walls with reinforcing steel as indicated on Drawings. Vertical reinforcing shall be fully grouted in masonry cores with grout.
- .11 Install insulation retaining wedges as work progresses taking care that mortar joint has achieved initial set before tamping wedges into place.
- .12 Lightly wet set masonry surfaces before laying abutting masonry.
- .13 Remove surplus mortar and mortar droppings as work progresses.
- .14 Lay blocks in running bond except as indicated otherwise.
- .15 Concave joints, strike joints flush in non-exposed areas or where shown on Contract Drawings.
- .16 Build in items supplied by other sections.
- .17 Fill built-in interior hollow metal frames with mortar.
- .18 Control joints:
 - .1 Provide continuous vertical control joints in block partitions in following locations:
 - .1 In new partitions in indicated locations and not spaced farther than 7.5 m o.c.
 - .2 On each side of column.
 - .2 Stop masonry reinforcement each side of control joint. Keep joint free of mortar.
- .19 Reinforced lintels:
 - .1 Install reinforced block lintels at openings.
 - .2 Provide minimum bearing of 200 mm at each side of opening.
 - .3 Install reinforcing bars and fill with concrete.
 - .4 Set block lintels in place using specified mortar.
- .20 Install masonry flashing over foundation walls on which masonry units bear, over lintels built into masonry and above roof flashing where roof abutts masonry.
- .21 Extend masonry flashing beyond exterior face and turn down 45° to form a drip, through outer wythe, up backing material minimum 200 mm and turn into joint at inner wythe. Lap joints 100 mm and apply adhesive.

3.5 CLEANING

- .1 Remove excess mortar and smears.
- .2 Point or replace defective mortar.

.3 Scrub surfaces clean.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements regarding the appearance and surface preparation for non-exposed, exposed and architecturally exposed priming, and finishing of the following metal items and assemblies:
 - .1 Structural steel framing
 - .2 Steel joists
 - .3 Steel deck
 - .4 Metal fabrications
 - .5 Ornamental metal fabrications
- .2 Architecturally exposed structural steel welds require a higher degree of workmanship and finishing than standard exposed structural steel or metal fabrication components.
- .3 Architecturally exposed structural steel is identified on the Structural and Architectural Drawings as AESS1, AESS2, AESS3 or AESS4 depending on the level of finish identified in this Section; definitions for AESS applies equally to structural steel, metal fabrications, and ornamental metal fabrications.
- .4 Architecturally exposed structural steel specifications and guidelines listed in this Section are based on recommended practices and procedures prepared by the Canadian Institute of Steel Construction (CISC).

1.2 RELATED REQUIREMENTS

- .1 Section 05 12 23 – Structural Steel
- .2 Section 05 21 00 – Steel Joist Framing
- .3 Section 05 31 00 – Steel Decking
- .4 Section 05 41 00 – Structural Metal Stud Framing
- .5 Section 05 50 00 – Metal Fabrications
- .6 Section 07 81 00 – Applied Fireproofing
- .7 Section 07 81 23 – Intumescent Fireproofing

1.3 DEFINITIONS

- .1 Non-Exposed Standard Structural Steel: Structural steel that is concealed in final construction; that is not subject to weathering or aggressive conditions; and that does not require special coatings to prevent corrosion.
 - .2 Exposed Standard Structural Steel: Structural steel that is exposed to view or concealed in final construction and is subject to weathering or aggressive conditions that require additional protection to prevent corrosion and loss of sectional area.
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- .3 Architecturally Exposed Structural Steel: The following finish levels for architecturally exposed structural steel as defined by CISC Code of Standard Practice, Table 1 are required by this specification, and apply to all forms of steel structures and metal fabrications identified:
- .1 AESS1 Basic Elements: Steel structure requiring enhanced workmanship having surface preparation to SSPC-SP6, sharp edges ground smooth, continuous weld appearance, and using standard structural bolts and with weld spatters removed.
 - .2 AESS2 Feature Elements Viewed at a Distance greater than 6 metres: Steel structure requiring enhanced workmanship as listed above for AESS1 and having fabrication tolerances reduced to ½ of standard, fabrication marks not apparent and with welds uniform and smooth.

1.4 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A153/A153M-05, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .3 ASTM A780-01 (2006), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .4 ASTM D4417-03, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
- .2 Canadian Standards Association (CSA):
 - .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .2 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding
 - .3 CSA W55.3-1965 (R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
 - .4 CSA W59-M1989 (R1998), Welded Steel Construction (Metal Arc Welding)
 - .5 CSA W178.2-1996, Certification of Welding Inspectors
- .3 Canadian Welding Bureau (CWB Group Industry Services):
 - .1 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide
- .4 Canadian Institute of Steel Construction (CISC):
 - .1 CISC/CPMA 1-73a 1975, A Quick-Drying One-Coat Primer for Use on Structural Steel
 - .2 CISC/CPMA Standard 2-75, A Quick-drying Primer For Use On Structural Steel
 - .3 CISC Code of Standard Practice 7th Edition, 2009
 - .4 CISC Code of Standard Practice, Appendix 1, Architecturally Exposed Structural Steel (AESS)

- .5 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):
 - .1 Coating Materials Guidelines
 - .2 Surface Preparation Guidelines:
 - .1 SSPC-SP3, Power Tool Cleaning
 - .2 SSPC-SP6/NACE No. 3, Commercial Blast Cleaning
 - .3 Application, Inspection and Quality Control Guidelines
 - .1 SSPC-QP 1, Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
 - .2 SSPC-QP 2, Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)
 - .3 SSPC-QP 3, Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
 - .4 SSPC-QP 5, Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies
 - .5 SSPC-QP 6, Standard Procedure for Evaluating the Qualifications of Contractors Who Apply Thermal Spray (Metallizing) for Corrosion Protection of Steel and Concrete Structures
- .6 Master Painter's Institute (MPI):
 - .1 Architectural Painting Specification Manual
- .7 The National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 AMP 505-88, Applied Coatings
 - .2 AMP 550-89, Metal Product Outline
 - .3 AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Conference: Conduct a pre-installation conference at Project site in accordance with requirements of Section 01 31 19 – Project Meetings before starting any work of this Section to review requirements for finishing architecturally exposed structural steel:
 - .1 Agenda for pre-installation conference will include, but not be limited to coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touch up painting, fabrication and erection procedures, and other requirements affecting metalwork finishing for the project.

- .2 Coordination: Coordinate coating requirements with affected Division 05 Sections with requirements specified for Section 09 91 99; establish responsibilities, pre-coating requirements and site finishing requirements.
 - .1 The use of bulk shop primers and temporary coatings for all exterior and interior architecturally exposed structural steel work will not be permitted unless it forms a part of a painting system specified in Section 09 91 99.
 - .2 Where non-complying primers are used, this section of work shall completely remove deficient primer from surfaces, and prepare and prime surfaces in accordance with the requirements of Section 09 91 99 for painted steel work at no additional cost to the Departmental Representative.
 - .3 Coordinate compatible shop primer for architecturally exposed structural steel with Section 09 91 99 as follows:
 - .1 This section will be responsible for surface preparation and application of compatible primer systems.
 - .2 Metal fabricators will be responsible for applying primer to match shop applied materials at site welds, immediately after completion of welds.
 - .3 Section 09 91 99 will perform minor site touch-up and repair to priming system, and apply finish coats of paint.
 - .4 This method of finishing has been specified to minimize primer and finish coating incompatibility, and to satisfy primer "open-time" limits for proper application of finish coats.
 - .5 The primers specified are intended to form a part of a total system and shall be compatible with and be produced by the same manufacturer as the finish coats.
 - .4 Coordinate installation of anchors for AESS members that connect to the work of other trades as follows:
 - .1 Furnish setting drawings, templates, and directions for installing anchors, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
 - .2 Deliver such items to the project site in time for installation.
 - .3 Indicate anchorage concepts shop drawings.

1.6 SUBMITTALS

- .1 Provide requested information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of coating products and primers that will receive subsequent architectural coatings indicating:
 - .1 Submit components and application procedures of the paint system as a single coordinated submittal and indicate compatibility and maximum recoat times for each product.
 - .2 Identify required surface preparation, primer, intermediate coat (if applicable) and finish coat.

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- .3 Coordinate submittal information with finish coat specified in Section 09 91 99.
 - .2 Shop Drawings: Submit shop drawings detailing fabrication of AESS components, as follows:
 - .1 Provide erection drawings clearly indicating which members are considered as AESS members.
 - .2 Include details that clearly identify requirements listed in for Fabrication and Erection; provide connections for exposed AESS consistent with concepts shown on the architectural or structural drawings.
 - .3 Indicate welds by standard CWB symbols, distinguishing between shop and site welds, and show size, length and type of each weld; identify grinding, finish and profile of welds as defined in this Section.
 - .4 Indicate type, size, finish and length of bolts, distinguishing between shop and site bolts; identify high strength bolted slip critical, direct tensioned shear/bearing connections; indicate which direction bolt heads should be oriented in final assembly.
 - .5 Clearly indicate which surfaces or edges are exposed and class of surface preparation.
 - .6 Indicate special tolerances and erection requirements as noted on the drawings or defined herein.
 - .3 Samples: Submit samples indicating welds and finishing techniques prior to starting any architecturally exposed welding and finishing work, as follows:
 - .1 Finish samples with primer listed in for use in this Section.
 - .2 Prepare samples free of tool marks, foundry identification marks, pits and scale and other defects detrimental to finished appearance.
 - .3 Sample will be used by the Departmental Representative to determine acceptability of welds and surface preparation for architecturally exposed structural steel fabrications on site.
 - .4 Departmental Representative may request modifications to the submitted sample; fabricator shall make the changes as indicated until acceptance is obtained from the Departmental Representative.
 - .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Qualification Statement: Submit qualification data for firms and persons fabricating and erecting AESS demonstrating their capabilities and experience when requested by the Departmental Representative; include lists of completed project names and address, and other information specified; and photographs showing detail of installed AESS in referenced projects.
 - .2 Certification: Submit SSPC certification listing qualifications of finish coating application for finish systems and type of work specified in this Section.
-

1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Fabricator: In addition to qualifications specified in Division 05, engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the Work.
 - .2 Erector: In addition to qualifications listed in Division 05, engage an experienced erector who has completed AESS work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Use special care in handling to prevent twisting or warping of AESS members:
 - .1 Erect pre-painted finish pieces using padded slings or other methods to protect them from damage arising from handling including, but not limited to, the following:
 - .2 Provide padding as required to protect while rigging and aligning member's frames.
 - .3 Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Departmental Representative during the pre-installation meeting.
 - .4 Submit methods of removing temporary erection devices and finishing, and refinishing pre-painted pieces for review and acceptance by the Departmental Representative prior to erection.
- .2 Storage and Handling Requirements: Store materials to permit easy access for review and identification; store steel members off ground by using pallets, platforms, or other supports; protect steel members and packaged materials from erosion and deterioration.

Part 2 Products

2.1 METAL MATERIALS

- .1 Coordinate requirements of this Section with related requirements of referenced Division 5 – Metals technical specification sections.

2.2 NON-EXPOSED STANDARD STRUCTURAL STEEL

- .1 Clean and prepare structural steel surfaces in accordance environmental exposure class as follows:
 - .1 Zone 0: Leave uncoated

2.3 SHOP FINISHING; EXPOSED STANDARD STRUCTURAL STEEL

- .1 Clean and prepare exposed structural steel surfaces in accordance with coating manufacturer's recommended profile and surface specification requirements; where they are more stringent than the minimums listed in this Section, and for the following environmental exposure classes:
 - .1 Zone 0: Leave uncoated
 - .2 Zone 1A: CISC/CPMA 2-75 over minimum SSPC-SP7
 - .3 Zone 1B: Shop prime using CISC/CPMA 2-75 over minimum SSPC- SP6 ready for site applied double finish coat of alkyd based enamel specified in Section 09 91 99
- .2 Do not prime exposed structural steel surfaces in the following conditions:
 - .1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only
 - .2 Surfaces that will be site welded
 - .3 Surfaces that will be high strength bolted with slip critical connections
 - .4 Surfaces that will receive sprayed applied fire resistant material
 - .5 Galvanized surfaces
- .3 Apply primer under cover, on dry surfaces only and when surface and air temperatures are at and rising, or above manufacturer's recommended minimum application temperature; and maintain temperature until primer is thoroughly cured.
- .4 Apply primer immediately after surface cleaning and priming in accordance with manufacturer's instructions and dry film thickness recommendations using methods as required to achieve full coverage of the following:
 - .1 Joints, corners, edges, and exposed surfaces
 - .2 Corners, crevices, bolts, welds, and sharp edges
 - .3 Apply second coat of shop primer to surfaces that will be inaccessible after assembly or erection; change colour of second coat.
- .5 Refer to Section 09 91 99 for coating and application requirements for application of site applied finishing systems.

2.4 SHOP FINISHING; ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

- .1 Clean and prepare architecturally exposed structural steel surfaces in accordance with coating manufacturer's recommended profile and surface specification requirements; where they are more stringent than the minimums listed in this Section.
- .2 Exposure Class: Zone 1A, as defined above for exposed structural steel using the primers systems listed below for AESS.
- .3 Primer for Bare Steel: As required by MPI Coating System specified in Section 09 91 99 and as follows:
 - .1 Surface preparation: Minimum SSPC-SP6 as required by Paint Finish System specified in Section 09 91 99.

2.5 GALVANIZING

- .1 Hot Dip Galvanized Finish: Hot dip galvanize in accordance with ASTM A123/A123M to locations indicated; 300 g/m² minimum zinc coating; galvanize components after assembly where size permits.

2.6 SHOP COATINGS

- .1 Isolation Coating: Acid and alkali resistant asphaltic paint to CAN/CGSB-1.108.
 - .1 Apply an isolation coating to contact surfaces of following components in contact with cementitious materials and dissimilar metals except stainless steel:
 - .1 Exterior components
 - .2 Interior components exposed to high humidity conditions
 - .2 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.
 - .3 Do not paint surfaces to be site welded. Prime and apply first finish coat after site welding has been completed, immediately prior to applying final finish coat to completed assembly.

2.7 FABRICATION OF ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

- .1 Fabricate and assemble AESS in the shop to the greatest extent possible in accordance with CISC requirements for Categories listed for the project and as follows:
 - .1 Detail AESS assemblies to minimize site handling and expedite erection.
 - .2 Fabricate AESS with exposed surfaces smooth, square and of surface quality consistent with the accepted sample.
 - .3 Use special care in handling and shipping of AESS both before and after shop painting.

2.8 SHOP CONNECTIONS

- .1 Bolted Connections: Make in accordance with Division 05 and 05 12 00
 - .1 Provide bolt type and finish as specified in this section; align bolt heads as indicated on shop and erection drawings.
- .2 Welded Connections:
 - .1 Comply with requirements specified in Division 05 and 05 12 00.
 - .2 Assemble and weld built-up sections by methods that maintain alignment of members without warp exceeding tolerances of this section.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify exposure of steel components, architectural or non-exposed, and finish assemblies as specified.

- .2 Report any discrepancy and potential problem areas to Departmental Representative for direction before commencing finishing operations.

3.2 APPLICATION OF PRIMERS AND COATINGS

- .1 Primer: Spray applied at fabrication shop by this Section, touch-up and recoating by Section 09 91 99, and as follows:
 - .1 Work primer into all corners
 - .2 Touch-up bare or worn areas on site after installation
 - .3 Leave surfaces unpainted as follows:
 - .1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only.
 - .2 Surfaces that will be site welded.
 - .3 Surfaces that will be high strength bolted with slip critical connections.
 - .4 Surfaces that will receive sprayed applied fire resistant material.

3.3 INSTALLATION OF ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

- .1 Set AESS accurately in locations and to elevations indicated in accordance with CISC requirements for Categories listed for the project and as follows:
- .2 Bolted Connections: Install bolts of specified type and finish in accordance with Section 05 12 00 and as follows:
 - .1 Bolt Head Alignment is indicated on Drawings: Orient bolt heads for each connection as indicated on erection drawings and verify orientation on site.
 - .2 Bolt Head Alignment is not indicated on Drawings; Orient bolt heads for each connection to one side acceptable to the Departmental Representative.
- .3 Welded Connections: Comply with CWB procedures for appearance; refer to Division 05 and 05 12 00 for other requirements, and as follows:
 - .1 Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - .2 Verify that weld sizes, fabrication sequence, and equipment used for AESS will limit distortions to allowable tolerances.
 - .3 Obtain Departmental Representative's acceptance for appearance of welds in repaired or site modified work.
 - .4 Make site welded profiles, quality, and finish consistent with mock-ups accepted prior to fabrication.
 - .5 Splice members only where indicated, or where found acceptable by the Departmental Representative.
 - .6 Obtain permission for any torch cutting or site fabrication from the Departmental Representative; finish sections thermally cut during erection to a surface appearance consistent with the mock up.
 - .7 Do not enlarge unfair holes in members by burning or by using drift pins; ream holes that must be enlarged to admit bolts; replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.

- .4 Site Quality Control: Perform testing and inspections in accordance with Division 05 to verify structural requirements for detailed bolt and weld connections.
- .5 Acceptance of AESS Appearance: Departmental Representative will observe AESS in place and determine acceptability based on mock-up and samples; repair, or remove and replace materials not meeting standard of workmanship up at no additional cost to the Departmental Representative.

3.4 ADJUSTING AND CLEANING

- .1 Site Touch-Up and Repair Shop Primer and Galvanized Finishes:
 - .1 Touch-Up Painting: Cleaning and touch-up painting of site welds, bolted connections, and abraded areas of shop paint shall be completed to blend with the adjacent surfaces in accordance with manufacturer's instructions as specified in Section 09 91 99.
 - .2 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM A36/A36M-08, Standard Specification for Structural Steel.
 - .2 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .4 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
 - .5 ASTM A490M-12, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).
 - .6 ASTM F1554, Standard Specification for Anchor Bolts, Steel, 55 ksi Yield Strength.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
 - .1 CISC/CPMA 1- 73a , Quick-Drying One-Coat Paint for Use on Structural Steel.
 - .2 CISC/CPMA 2- 75 , Quick-Drying Primer for use on Structural Steel.
- .4 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA-S16-09, Design of Steel Structures.
 - .3 CAN/CSA-S136-07(R2012), North American Specification for the Design of Cold Formed Steel Structural Members.
 - .4 CSA-S136.1-01, Commentary on North American Specification for the Design of Cold Formed Steel Structural Members.
 - .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
 - .6 CSA-W48-06 (R2011), Filler Metals and Allied Materials for Metal Arc Welding.
 - .7 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .8 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
- .5 Master Painters Institute:
 - .1 Architectural Painting Specification Manual
 - .2 MPI-INT 5.1- 08 , Structural Steel and Metal Fabrications.
 - .3 MPI-EXT 5.1- 08 , Structural Steel and Metal Fabrications.

- .6 The Society for Protective Coatings (SSPC):
 - .1 SSPC SP 6/NACE No. 3- 06 , Commercial Blast Cleaning.

1.2 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CSA-S16 and CAN/CSA-S136 with CSA-S136.1 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
- .3 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
- .4 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .5 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non standard connections.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00.
- .2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:
 - .3 Description of methods.
 - .4 Sequence of erection.
 - .5 Type of equipment used in erection.
 - .6 Temporary bracings.
- .7 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.

1.5 QUALITY ASSURANCE

- .1 Submit 2 copies of mill test reports 4 weeks prior to fabrication of structural steel.
 - .2 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .3 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.
-

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CAN/CSA-G40.20/G40.21 Grade 350W, minimum 30% recycled content.
- .2 Anchor bolts: to ASTM F1554 Grade 55, minimum 30% recycled content.
- .3 High strength anchor bolts: to ASTM A490, minimum 30% recycled content.
- .4 Bolts, nuts and washers: to ASTM A325, minimum 30% recycled content.
- .5 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .6 Shop paint primer: to CISC/CPMA 1.
- .7 Hot dip galvanizing: galvanize steel, where indicated, to ASTM A123/A123M, minimum zinc coating of 600 g/m², Coating Grade 85.
- .8 Shear studs: to CSA W59, Appendix H.

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CSA-S16 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds. Grind smooth.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CSA-S16.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces to receive field installed stud shear connections.
 - .3 Surfaces and edges to be field welded.
 - .4 Faying surfaces of friction-type connections.
 - .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 EXECUTION

3.1 GENERAL

- .1 Structural steel work: in accordance with CSA-S16.

- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 01 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.3 MARKING

- .1 Mark materials in accordance with CAN/CSA- G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CSA-S16 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: Not permitted unless approve in writing by Departmental Representative.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .3 Submit test reports to Departmental Representative within 1 week of completion of inspection.
- .4 Departmental Representative Owner will pay costs of tests as specified in Section 01 29 83.
- .5 Test shear studs in accordance with CSA W59.

3.6 FIELD PAINTING

- .1 Paint in accordance with Section 09 91 99.
 - .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB-85.10.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals. (withdrawn)
- .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
 - .1 CISC/CPMA 2-75-1975, Quick-Drying, Primer for Use on Structural Steel.
 - .2 CISC/CPMA 1-73a-1975, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .3 CSA International:
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA S16-09, Design of Steel Structures.
 - .3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
 - .4 CSA W55.3-08, Certificate of Companies for Resistance Welding of Steel and Aluminum.
 - .5 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
- .4 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual - current edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for steel joist framing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.
 - .3 Indicate particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.
 - .4 Delegated Design Submittals:
 - .1 Submit floor vibration analysis as directed by Departmental Representative.
-

- .2 Submit 2 copies of calculations and joist design drawings for typical joists to Departmental Representative for review at least 4 weeks prior to fabrication and/or delivery.

1.3 QUALITY ASSURANCE

- .1 Submit 2 copies of mill test reports at least 4 weeks prior to fabrication of steel joists and accessories. Reports to show:
- .2 Chemical and physical properties.
- .3 Other details of steel to be incorporated into work.
- .4 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

- .1 Design steel joists and bridging to carry loads indicated in joist schedule shown on drawings to CSA S16.
- .2 Design joists and anchorages for uplift forces as indicated.
- .3 Ensure joists are manufactured to consider load effects due to fabrication, erection and handling.
- .4 Limit natural frequency of joist and floor system to 4-8 Hz and peak acceleration to 0.5%g maximum.
- .5 Limit roof joist deflection due to specified live load to span/360 maximum and deflection due to specified total load span/240 maximum.
- .6 Limit floor joist deflection due to specified live load to span/480 maximum and deflection due to specified total load to span/240 maximum.

2.2 MATERIALS

- .1 Open web steel joists: to CSA S16.
- .2 Structural steel: to CSA G40.20/G40.21.
- .3 Welding materials: to CSA W59.
-

- .4 Shop paint primer: to MPI - INT 5.1A CISC/CPMA-1.

2.3 FABRICATION

- .1 Fabricate steel joists and accessories as indicated in accordance with CSA S16 and in accordance with reviewed shop drawings.
- .2 Weld in accordance with CSA W59.
- .3 Provide bottom chord extensions where indicated.
- .4 Provide diagonal and horizontal bridgings and anchorages as indicated.
- .5 Install shear studs in accordance with CSA W59.

2.4 SHOP PAINTING

- .1 Clean, prepare and shop prime surfaces of steel joists to CSA S16.
- .2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.
- .3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces and edges to be field welded.
 - .3 Faying surfaces of friction-type connections.
 - .4 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel joist framing 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.

3.2 INSTALLATION

- .1 Do structural steel work: to CSA S16.
- .2 Do welding: in accordance with CSA W59.

- .3 Ensure installers are certified to CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.
- .4 Submit certification that welded joints are qualified by Canadian Welding Bureau.

3.3 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work; report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.4 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
 - .1 Testing laboratory will inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory will also monitor test loading of joists used by manufacturer to verify design and check representative field connections. Departmental Representative will determine extent of and identify all inspections.
 - .2 Submit test report to Departmental Representative within 7 days after completion of inspection.
- .2 Departmental Representative will pay costs of tests as specified in Section 01 29 83.
- .3 Test shear studs to CSA W59.

3.5 ERECTION

- .1 Erect steel joists and bridging as indicated to CSA S16 and in accordance with reviewed erection drawings.
- .2 Complete installation of bridging and anchorages before placing construction loads on joists.
- .3 Field cutting or altering joists or bridging that are not shown on shop drawings: not permitted unless approve in writing by the Departmental Representative.
- .4 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.6 FIELD PAINTING

- .1 Paint: in accordance with Section 09 91 00.
- .2 Touch up all damaged surfaces and surfaces without shop coat with MPI - INT 5.1A CISC/CPMA-1 in accordance with manufacturers' recommendations.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
-

3.8 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating. (withdrawn)
- .3 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-S16-09, Design of Steel Structures.
 - .2 CSA-S136-07 (R2012), North American Specification for the Design of Cold Formed Steel Structural Members.
 - .3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .4 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .5 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding) Metric.
- .4 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 10M-08, Standard for Steel Roof Deck.
 - .2 CSSBI 12M-08, Standard for Composite Steel Deck.

1.2 DESIGN REQUIREMENTS

- .1 Design steel deck using limit states design in accordance with CSA-S136, CSSBI 10M and CSSBI 12M.
- .2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.
- .3 Deflection under specified live load not to exceed 1/240 of span, except that when gypsum board ceilings are hung directly from deck, live load deflection not to exceed 1/360 of span.
- .4 Where vibration effects are to be controlled as indicated, dynamic characteristics of decking system to be designed to be in accordance with CAN/CSA-S16.1, Appendix 'G'.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings erection and shoring drawings in accordance with Section 01 33 00.
 - .2 Submit drawings stamped and signed by qualified professional engineer registered or licensed in Province of Ontario, Canada.
 - .3 Submit design calculations if requested by Departmental Representative.
-

- .4 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
- .5 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 255, minimum 30% recycled content, with ZF75 coating, for interior surfaces not exposed to weather, painted finish, 0.76 mm minimum base steel thickness.
- .2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
- .3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 255 minimum 30% recycled content, with ZF275, coating, regular spangle surface, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.76 mm minimum base steel thickness.
- .4 Closures: as indicated in accordance with manufacturer's recommendations.
- .5 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm, minimum 30% recycled content. Metallic coating same as deck material.
- .6 Primer: zinc rich, ready mix to CAN/CGSB-1.181, Ecologo certified.
- .7 Caulking: to Section 07 90 00.
- .8 Shear studs: to CSA W59.

2.2 TYPES OF DECKING

- .1 Steel deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, interlocking side laps. Flat sheet for cellular deck, 0.76 mm minimum base steel thickness.
- .2 Composite steel deck: 0.76 mm minimum base steel thickness, 38 mm deep profile, upright embossed fluted profile, interlocking side laps. Flat sheet for cellular deck, 0.76 mm minimum base steel thickness.
- .3 Cellular deck for electrical raceway: to CSA-C22.2 No.79.

Part 3 EXECUTION

3.1 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M and CSSBI 12M.
- .2 Welding: in accordance with CSA W59, except where specified otherwise.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

3.2 ERECTION

- .1 Erect steel deck as indicated and in accordance with CSA-S136, CSSBI 10M and CSSBI 12M and in accordance with reviewed erection drawings.
- .2 Lap ends: to 50 mm minimum.
- .3 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59.
- .4 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.
- .5 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mill scale and other foreign matter.
- .6 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.
- .7 Place and support reinforcing steel as indicated.

3.3 CLOSURES

- .1 Install closures in accordance with approved details.

3.4 OPENINGS AND AREAS OF CONCENTRATED LOADS

- .1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.
- .2 Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.
- .3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

3.5 CONNECTIONS

- .1 Install connections in accordance with CSSBI recommendations as indicated.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A591/A591M-98, Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications. (Withdrawn)
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-S136-07 (R2012), North American Specification for the Design of Cold Formed Steel Structural Members.
 - .2 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .3 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum
 - .4 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding) (Metric Version).
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 Canadian Sheet Steel Building Institute CSSBI 52M-91, Lightweight Steel Framing Binder.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate design loads, member sizes, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes and spacing, and anchors.
- .3 Indicate locations, dimensions, openings and requirements of related work.
- .4 Indicate welds by welding symbols as defined in CSA W59.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
 - .2 Submit samples of framing components and fasteners to Departmental Representative if requested.
-

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Steel: to CSA-S136, fabricated from ASTM A653/A653M, Grade A to D steel.
- .2 Zinc coated steel sheet: quality to ASTM A653/A653M, with Z275 designation zinc coating.
- .3 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 33 with AZM150 coating, regular spangle surface, chemically treated for unpainted finish.
- .4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .5 Screws: pan head, self-drilling, self-tapping sheet metal screws, corrosion protected to minimum requirements of CSSBI, length 10 mm minimum.
- .6 Anchors: concrete expansion anchors or other suitable drilled type fasteners.
- .7 Bolts, nuts, washers: hot dipped galvanized to CAN/CSA-G164, 600 g/m² zinc coating.
- .8 Touch up primer: zinc rich, to CAN/CGSB- 1.181.

2.2 STEEL STUD DESIGNATIONS

- .1 Colour code steel studs in accordance with CSSBI 50M.

2.3 METAL FRAMING

- .1 Steel studs: to CSA-S136, fabricated from zinc coated steel, depth as indicated. Minimum steel thickness of 0.91 mm.
- .2 Stud tracks : fabricated from same material and finish as steel studs, depth to suit.
 - .1 Bottom track: single piece.
 - .2 Top track: single piece with vertical slot hole.
- .3 Bridging: fabricated from same material and finish as studs, 38 x 12 x 1.22 mm minimum thickness.
- .4 Angle clips: fabricated from same material and finish as studs, 38 x 38mm x depth of steel stud, 1.22 mm minimum thickness.
- .5 Tension straps and accessories: as recommended by manufacturer.

2.4 SOURCE QUALITY CONTROL

- .1 Prior to commencement of work, submit:
- .2 Two certified copies of mill reports covering material properties.

Part 3 EXECUTION

3.1 GENERAL

- .1 Do welding in accordance with CSA W59.
 - .2 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.
-

- .3 Do work in accordance with CSSBI 52M.

3.2 ERECTION

- .1 Erect components to requirements of reviewed shop drawings.
- .2 Anchor tracks securely to structure at 800 mm oc maximum, unless lesser spacing prescribed on shop drawings.
- .3 Erect studs plumb, aligned and securely attached with two screws minimum, or welded in accordance with manufacturer's recommendations.
- .4 Seat studs into bottom tracks and single piece top track.
- .5 Install studs at not more than 50.0 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .6 Brace steel studs with horizontal internal bridging at 1200 mm maximum. Fasten bridging to steel clips fastened to steel studs with screws or by welding.
- .7 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.
- .8 Touch up welds with coat of zinc rich primer.

3.3 ERECTION TOLERANCES

- .1 Plumb: not to exceed 1/500th of member length.
- .2 Camber: not to exceed 1/1000th of member length.
- .3 Spacing: not more than 3.0 mm from design spacing.
- .4 Gap between end of stud and track web: not more than 4.0 mm.

3.4 CUTOUTS

- .1 Maximum size of cutouts for services as follows:

Member Depth Depth (mm)	Across Member Length	Along Member Spacing	Centre to Centre
92	40 max.	105 max.	600 min.
102	40 max.	105 max.	600 min.
152	65 max.	115 max.	600 min.

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International:
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating (withdrawn).
- .3 CSA International:
 - .1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CSA C22.1-12, Canadian Electrical Code.
 - .3 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .4 CSA S16-09, Design of Steel Structures.
 - .5 CSA W48-06 (R2011), Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .6 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
- .4 Environmental Choice Program:
 - .1 CCD-047-98(R2005), Architectural Surface Coatings.
- .5 Green Seal Environmental Standards (GS):
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 43.

- .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 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:
- .4 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .5 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Stainless steel sheet, strip, plate and flat bar: to ASTM A666, type 304, AISI No. 4 finish, minimum 75% recycled content.
- .2 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W, minimum 30% recycled content.
- .3 Steel pipe: to ASTM A53/A53M double extra strong, black finish.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts and anchor bolts: to ASTM A307.
- .7 Galvanizing: hot dip, unpassivated, to ASTM A123/A123M, Coating Grade 85, minimum 600 g/m².
- .8 Zinc rich primer for galvanized surfaces: zinc rich, readymix to CAN/CGSB-1.181, Ecologo certified.

- .9 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.
- .10 Tube Forms: Spirally wound, adhesive laminated fibre paper tube forms having bursting pressure of 965 kPa, coated with hot wax, diameters as required.
- .11 Concrete: Minimum 21 MPa (3,000 psi) concrete conforming to CAN/CSA-A23.1/A23.2.
- .12 Security fasteners:
 - .1 Provide security screws, security nuts, rivets, spanner screws or other equally secure approved devices for affixing various items, ie torx pin head, socket pin head, phillips pin head, hex pin head or equivalent.
 - .2 Spanner screws to have slots that require a special spanner tool to remove screws.
 - .3 Round head screws not acceptable except at locations approved where material is not thick enough to permit counter-sinking.
 - .4 Standard screws not acceptable.

2.2 FABRICATION

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

2.3 STAINLESS STEEL WORK

- .1 Take all necessary precautions to safeguard against latent surface discolouration due to disturbance of the natural protective oxide coating of the material or to contamination from other sources.
- .2 Workmanship shall be the best standard practice for this type of work. Execute stainless steel work in accordance with the applicable instructions set forth in Atlas Stainless Steels' "Technical Data" handbook on stainless steel.
- .3 Do all stainless steel fabrication in clean shops, located away from areas where carbon steel is burnt, ground, or cut with abrasive wheels to ensure that carbon steel dust will not be embedded into the stainless steel, and as follows:
 - .1 In fabrication of stainless steel do not use tools and dies which have been used on carbon steels.
 - .2 Ensure tools and dies use for forming and cutting stainless steel are free of nicks and other damage.
 - .3 Do not use carbon grits and grinding wheels which will imbed foreign particles into stainless steel surfaces. Use only stainless steel wool when wool polishing is required.
 - .4 Stainless steel items, on which rust stains appear, shall be replaced with new fabricated material.

2.4 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m², Coating Grade 85, to ASTM A123/A123M.
- .2 Shop coat primer: in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.
- .3 Zinc primer: zinc rich, ready mix in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.

2.5 SHOP PRIMING

- .1 Primer: VOC limit 250 g/L maximum to GS-11.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

2.6 ANGLE LINTELS

- .1 Steel angles: galvanized or prime painted as specified, sizes indicated for openings. Provide 150 mm minimum bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated.
- .3 Finish: shop painted.
 - .1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

2.7 PIPE RAILINGS

- .1 Design railings to withstand minimum horizontal and vertical loads as required to meet requirements of authorities having jurisdiction. In no instance shall load design of railings be less than 2.2 kN/m horizontally and 1.5 kN/m vertically.
 - .2 Steel pipe: 50mm nominal outside diameter, formed to shapes and sizes as indicated.
 - .3 Shop coat prime interior railings after fabrication.
 - .4 Handrail bracket: Fabricate as shown. After fabrication, galvanized bracket in accordance with ASTM A123/A123. Secure brackets to wall.
 - .5 Set railing standards in concrete with grout, trowel surface smooth and flush with adjoining surface.
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2.8 SHOP FABRICATED STAINLESS STEEL HANDRAILS

- .1 Rails (stainless steel round tubing):
 - .1 38 mm diameter.
 - .2 Nominal Thickness: 1.6 mm.
 - .3 Finish: Stainless Steel No. 304
- .2 Fittings: stainless steel.
- .3 Mounting: Adjustable brackets and flanges, with stainless steel inserts, brackets, and/or backing plates as appropriate for substrate.
- .4 Splice Connectors: concealed spigot; stainless steel.
- .5 Exposed Fasteners: stainless steel flush countersunk screws or bolts; consistent with design of railing.

2.9 LATERAL SUPPORT ANGLES FOR MASONRY PARTITIONS

- .1 Supply masonry section with steel angles to provide lateral support of masonry partitions where they abutt the underside of deck.
- .2 Apply alkyd primer.

2.10 CORNER GUARDS

- .1 Steel angle: 75 x 75x 6mm thick x 1200 mm high, with 3 anchors each guard.
- .2 Galvanized finish for exterior, prime paint for interior.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11 when applied onsite.

2.11 ACCESS LADDERS

- .1 Stringers: 75 x 75 x 8 mm thick, steel angle.
- .2 Steel Rungs: 20 mm diameter, welded to stringers.
- .3 Brackets: sizes and shapes as indicated, weld to stringers at 1000 mm on centre, complete with fixing anchors.
- .4 Ladders in elevator pits shall extend 1220 mm high above finished floor.
- .5 Provide safety cages around ladders where indicated on Drawings, in accordance with authorities having jurisdiction.
- .6 Galvanize finish for exterior, prime paint for interior.
- .7 Galvanize exterior ladders after fabrication.

2.12 CHANNEL FRAMES

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Weld 50 x 250 x 6.4 mm thick steel strap anchors to channel jamb frame at 600 mm on centre.

- .4 Finish: prime coat painted.

2.13 ELEVATOR HOIST BEAM

- .1 Provide elevator hoist beam and divider beam: Structural steel sections, sizes indicated on drawings, Finish: Prime painted. Coordinate with Section 14 25 70 as required for sizing and installation of noted beams.

2.14 BENCH SUPPORTS

- .1 Supply only, for installation under work of Section 06 40 01, bench supports constructed of steel plates of sizes noted. Provide supports at maximum 609 mm centres and not less than 152 mm from ends of bench run.
- .2 Construct supports as detailed. Provide all drill holes required for concealed anchorage of wood bench and for anchoring to building structure.

2.15 MISCELLANEOUS STEEL BRACKETS, SUPPORTS AND ANGLES

- .1 Supply and install or supply for installation by trades responsible, all loose steel brackets, supports and angles where indicated, except where such brackets, supports and angles are specified under work of other Sections. Drill for countersunk screws, expansion anchors and anchor bolts.
- .2 Unless otherwise specified, prime paint for interior installation; galvanized finish for exterior installation.

2.16 PIVOTING CAMERA POLE

- .1 Provide pivoting camera pole in accordance with reviewed shop drawings and manufacturer's written instructions.
- .2 Pole to be complete with all components and accessories as required for complete and functional installation of assembly, including but not limited to the following:
- .1 Fabricated from high tensile steel.
 - .2 Hot dipped galvanized after fabrication.
 - .3 Pre-finished in colour selected by Departmental Representative.
 - .4 Surface bolted with internal nuts to poured concrete foundation.
 - .5 Designed to withstand windload.
 - .6 A low for conduit for video surveillance camera and mount.
- .3 Height and size: As indicated.
- .4 Coordinate with Section 28 23 00 - Video Surveillance for mounting of CCTV.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications 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.

3.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16 or Weld field connection.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 PIPE RAILINGS

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

3.4 LATERAL SUPPORT ANGLES FOR MASONRY PARTITIONS

- .1 Supply masonry section with steel angles to provide lateral support of masonry partitions where they abutt the underside of deck.
- .2 Apply alkyd primer.

3.5 CORNER GUARDS

- .1 Install corner guards in locations as indicated.

3.6 ACCESS LADDERS

- .1 Install access ladders in locations as indicated.
 - .2 Erect ladders 200 mm clear of wall on bracket supports.
-

3.7 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

3.8 BENCH SUPPORTS

- .1 Supply steel bench supports as specified.
- .2 Galvanize surfaces.

3.9 PIVOTING CAMERA POLE

- .1 Install pivoting camera pole in accordance with reviewed shop drawings and manufacturer's written instructions, vertical and secure.
- .2 Coordinate with Section 28 23 00 - Video Surveillance for mounting of CCTV as required for installation of CCTV components.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.11 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM):
 - .1 ANSI/NAAMM MBG 531-09, Metal Bar Grating Manual.
- .2 ASTM International:
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A325M-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.
 - .4 ASTM A490-12, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer. (withdrawn)
 - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating. (withdrawn)
- .4 CSA International:
 - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
- .5 National Association of Architectural Metal Manufacturers(NAAMM):
 - .1 AMP 510-92, NAAMM Metal Stairs Manual.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
 - .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for stairs, 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 Province of Ontario, Canada.
 - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

1.3 QUALITY ASSURANCE

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

- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect stairs from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
- .2 Design metal stair and landing construction and connections to NBC vertical and horizontal live load requirements.
- .3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 MATERIALS

- .1 Steel sections: to CSA G40.20/G40.21 Grade 300W for angles, channels and plates, Grade 350W for W Shape.
 - .2 Steel plate: to CSA G40.20/G40.21, Grade 300W.
 - .3 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.
 - .4 Steel tubing: to CSA G40.20/G40.21, Grade 350, wall thickness, sizes and dimensions as indicated.
 - .5 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with corrugated nosings.
 - .6 Welding materials: to CSA W59.
 - .7 Bolts: to ASTM A325.
 - .8 High strength bolts: to ASTM A490.
-

2.3 CONCRETE FILL AND REINFORCING MATERIALS

- .1 Concrete materials and properties shall be in accordance with specified requirements in Division 03 – Structural Concrete, and as follows:
 - .1 Concrete: Normal weight, ready mixed concrete conforming to CAN/CSA A3000, and having minimum 20 MPa compressive strength at 28 days.
 - .2 Welded wire fabric: Minimum 150 x 150 MW9.1/9.1 conforming to ASTM A185, galvanized for exterior locations.
 - .3 Non-slip aggregate finish: Factory packaged abrasive aggregate made from fused, aluminum-oxide grit; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.

2.4 FABRICATION

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

2.5 STEEL PAN STAIRS

- .1 Fabricate stairs with closed riser steel pan construction.
- .2 Form treads and risers from 3 mm thick steel plate. Secure treads and risers to L 35 x 35 x 5 horizontal and vertical welded to stringers.
- .3 Form wall stringers from MC 310 x 15.8 minimum.
- .4 Form outer stringers from MC 310 x 15.8 minimum with 5 mm thick plate fascia welded on.
- .5 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
- .6 Extend stringers around mid landings to form steel base.
- .7 Close ends of stringers where exposed.

2.6 PLATE/ GRATING STAIRS

- .1 Form treads from 8 mm thick steel plate to profile indicated, and secure to stringers with L 35 x 35 x 5 supports minimum.
 - .2 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.
 - .3 Form stringers from MC 310 x 15.8 minimum.
-

2.7 BALUSTRADES

- .1 In accordance with Section 05 73 13 – Glazed Decorative Metal Railings. Coordinate with noted Section as required for sizing and installation.

2.8 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m², Coating Grade 85, to ASTM A123/A123M.
- .2 Shop coat primer: to CAN/CGSB-1.40.
- .3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.9 SHOP PAINTING

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

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and ladders 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.

3.2 INSTALLATION OF STAIRS

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

3.3 STAIR AND RAILING SCHEDULE

- .1 Feature Stair:
 - .1 Configuration: As indicated on Drawings
 - .2 Stringers: Structural Steel Channel, Closed Face, size in accordance with delegated design requirements; having a minimum 25 mm clear between tip of nosing and back of tread to face of channel; close ends of stringers where exposed.
 - .3 Treads and Risers:
 - .1 Construction: Concrete filled pan, perforated metal riser
 - .2 Deflection: L/360
 - .4 Landings: Concrete filled steel pan reinforced with channels, to provide smooth soffit surface.
 - .5 Railings: Glass panel and as detailed on Drawings.
 - .6 Handrails: As detailed on Drawings.
 - .7 Usage Classification: Architectural
- .2 Egress Stair:
 - .1 Configuration: As indicated on Drawings.
 - .2 Stringers: Structural Steel Channel, Closed Face, size in accordance with delegated design requirements; having a minimum 25 mm clear between tip of nosing and back of tread to face of channel; close ends of stringers where exposed.
 - .3 Treads and Risers:
 - .1 Construction: Concrete filled pan, closed riser.
 - .2 Deflection: L/360
 - .4 Landings: Concrete filled steel pan reinforced with channels, to provide smooth soffit surface.
 - .5 Railings: Pipe as detailed on Drawings.
 - .6 Handrails: As detailed on Drawings
 - .7 Usage Classification: Commercial

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of pre-engineered, modular, glazed structural metal railings with glass guards or balustrades; using glass as the major structural component.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A240/A240M-11b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - .2 ASTM A269-07a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
 - .3 ASTM A276-06, Standard Specification for Stainless Steel Bars and Shapes
 - .4 ASTM A554-03, Standard Specification for Welded Stainless Steel Mechanical Tubing
 - .5 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
 - .6 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .7 ASTM C1107/C1107M-07a, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - .8 ASTM E488-96 (2003,) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
 - .9 ASTM E2353-06, Standard Test Methods for Performance of Glass in Permanent Glass Railing Systems, Guards, and Balustrades
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate installation of anchorages for railings; provide setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry and coordinate delivery so that items are at Project site in time for installation.
 - .1 Scheduling: Schedule installation so wall attachments are made only to completed walls; do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Action Submittals:
 - .1 Product Data: Submit product data for product lines of railings assembled from standard components, and for grout, anchoring cement, and coating products.
 - .2 Shop Drawings: Submit shop drawings indicating plans, elevations, sections, details, and attachments to other work including; but not limited to, the following:
 - .1 Structural analysis data for installed products indicated to meet design loads signed and sealed by a qualified professional engineer responsible for preparation.
 - .2 Sections and plans of railings indicating dimensions and assembly of components.
 - .3 Indicate fasteners, welds and connection details between railings; handrails; brackets; reinforcements; anchors; and welded and bolted connections.
 - .4 Methods and locations of all exposed fastenings.
 - .5 Methods and locations of specified finishes.
 - .6 Verify dimensions with site conditions before fabricating:
 - .1 Shop drawings shall indicate verified or established dimensions only.
 - .2 Terms containing words similar to “verify” or “confirmed by others” will not be acceptable.
 - .3 Samples: Submit samples for verification by Departmental Representative for each type of exposed finish required and as follows:
 - .1 Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - .2 Each type of glass required.
 - .3 Fittings and brackets.
 - .4 Welded connections.
 - .5 Assembled Samples of railing systems, made from full size components, including top rail, post, handrail, and infill:
 - .1 Show method of finishing members at intersections.
 - .2 Samples need not be full height.
- .3 Informational Submittals: Provide the following submittals within two weeks of award of contract for work of this Section:
 - .1 Source Quality Control Submittals:
 - .1 Submit manufacturer’s testing results indicating compliance with applicable performance standards, codes and requirements of this specification

- .2 Provide detailed description of results of tests performed including identification of glass rail, guard or balustrade assembly; detailed description of glazing materials, glass type and treatment, glass thickness and component manufacturer's details applicable to installation of work identified in this Section.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Manufacture glass guard and balustrade supports and components in accordance with CAN/CGSB 12.20 and ASTM E2353.
- .2 Qualifications:
 - .1 Installer: Use installers approved by decorative metal railings manufacturer having experience with similar extent and complexity as that required by work of this Section.
 - .2 Welders: Perform structural welding using welders certified by CWB for each type of weld required within past 12 months.
- .3 Appearance of Finished Installation: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics:
 - .1 Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - .2 Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
 - .3 Do not modify intended aesthetic effects, as judged solely by Departmental Representative, except as specifically directed and accepted by the Departmental Representative'.
 - .4 Submit comprehensive explanatory data to Departmental Representative for review where modifications are proposed to meet performance characteristics.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
 - .2 Store materials in clean, dry area indoors in accordance with manufacturer's written instructions.
 - .3 Do not store materials directly on floor.
 - .4 Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - .5 Protect materials and finish during handling and installation to prevent damage.
 - .6 Protect glass infill panels from edge damage.
-

1.7 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where prefabricated decorative metal railing systems are indicated to fit between, around or be fastened to other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating where prefabricated decorative metal railing systems without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 STRUCTURAL METAL RAILINGS

- .1 Design Requirements: Design railings capable of withstanding the effects of gravity loads and the following loads and stresses in accordance with Authorities Having Jurisdiction and the following:
 - .1 Handrails, Top Rails and Guards:
 - .1 Uniform load of 0.75 kN/m applied in any direction.
 - .2 Concentrated load of 1.00 kN at any point applied horizontally to top rail and 1.5 kN applied vertically to top rail.
 - .3 Individual elements within the assembly designed for a concentrated load of 0.5 kN at any point in the element.
 - .4 Loads indicated for top rail need not occur simultaneously.
 - .5 Design loads for balustrades are same as for railings.
 - .2 Infill of Guards:
 - .1 Uniform load of 1.2 kN/m² applied horizontally.
 - .2 Loads indicated for infill load and other loads do not occur simultaneously.
 - .3 Loading Locations:
 - .1 Height: Apply load at minimum 1070 mm from floor.
 - .2 Free Standing Glass: Capped by a rail that is continuous over three lites; glass guard shall resist factored design load after failure of alternate lites.
 - .3 Maximum Deflection: Limit deflection of guard at point of application of load to a maximum of 40 mm; determined by glass failure or removed glass in accordance with CAN/CGSB 12.20 and ASTM E2353.
- .2 Component Materials:
 - .1 Provide materials free from pitting, seam marks, roller marks, stains, discolorations and other imperfections where exposed to view on finished units.
 - .2 Aluminum: Aluminum alloy and temper recommended by manufacturer for type of use and finish indicated and as follows:
 - .1 Extruded Bar and Tube: Meeting requirements of ASTM B221, alloy 6063-T5 or T52.
 - .2 Extruded Structural Pipe and Tube: Meeting requirements of ASTM B429, alloy 6063-T832.

- .3 Drawn Seamless Tube: Meeting requirements of ASTM B210M, alloy 6063-T832
 - .4 Plate and Sheet: Meeting requirements of ASTM B209M, Alloy 6061-T6.
 - .5 Die and Hand Forgings: Meeting requirements of ASTM B247M, alloy 6061-T6.
 - .6 Castings: Meeting requirements of ASTM B26M, alloy A3546-T6.
 - .3 Stainless Steel:
 - .1 Sheets and Plates: Meeting requirements of ASTM A240/A240M and A666.
 - .2 Bars and Shapes: Meeting requirements of ASTM A276.
 - .3 Tubing: Meeting requirements of ASTM A269 and A554.
 - .3 Pre-Engineered Structural Glass Railings:
 - .1 Mounting Configuration: Type V One Side Support with Surface Attached/Bolted Handrail– Structural
 - .2 Handrails: Round; stainless steel; directional satin finish.
 - .3 Structural Glass Panels: Tempered glass as specified in Section 08 81 00 in thicknesses not less than manufacturer’s structural performance requirements for installations indicated, and as follows:
 - .1 Colour: Clear acid etch
 - .2 Sizes: Fabricate to sizes required with edge clearances and tolerances in accordance with glass manufacturer.
 - .3 Thickness: 16 mm
 - .4 Shapes: Straight.
 - .5 Edge: 1 mm maximum chamfer, grind and polish exposed edges before tempering.
 - .6 Labelling: Permanently mark glass with certification label of safety glazing certification council or other certification agency acceptable to Authority Having Jurisdiction.
 - .4 Handrail Brackets: Rectangular; stainless steel; directional satin finish.
 - .5 Floor Mount Plates: Recessed mounted extruded aluminum shoe of width to accommodate glass thickness with stainless steel, satin directional finish decorative cladding.
 - .6 Handrail Stainless steel, round, satin directional finish.
 - .7 Handrail Brackets:
 - .1 Type: Bolt through.
 - .2 Material: Stainless steel.
 - .3 Finish: Directional satin finish.
 - .8 Hardware: Stainless steel, Type 304, finish to match adjacent materials.
-

- .4 Accessories:
- .1 Anchors: Provide post installed anchors as recommended by manufacturer for anchoring to concrete slab and metal stud gypsum board wall assemblies, and as follows:
 - .1 Material: Stainless steel, Type 304.
 - .2 Safety Factor: Capable to sustain, without failure, load imposed with a safety factor of 4, as determined by testing in accordance with ASTM E488.
 - .2 Brackets and Flanges: Cast of formed metal of same type of material and finish as supported rails and as follows:
 - .1 Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.
 - .2 Provide formed or cast brackets with predrilled holes for exposed bolt anchorage.
 - .3 Provide formed steel brackets with predrilled holes for bolted anchorage and with snap-on covers that match rail finish and conceals bracket base and bolt head.
 - .4 Provide brackets with interlocking pieces that conceal anchorage; locate set screws on bottom of brackets.
 - .3 Welding Rods and Bare Electrodes: Select in accordance with CWB specifications for metal alloy welded; provide type and alloy recommended by producer of metal being welded and as required for color match, strength, and compatibility in fabricated items.
 - .4 Bituminous Paint: Cold applied asphalt emulsion in accordance with ASTM D1187, to separate dissimilar metals and concrete in contact with aluminum components.
 - .5 Non-Shrink, Non-Metallic Grout: Factory packaged, non-staining, non-corrosive, non-gaseous expanding grout, having a minimum 55 MPa compressive strength; in accordance with ASTM C1107; specifically recommended by manufacturer for interior applications.
 - .6 Anchoring Cement: Manufacturer recommended, factory packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching and grouting compound.

2.2 FABRICATION

- .1 Fabricate decorative metal railings for compliance with structural requirements of building code and requirements of Authority Having Jurisdiction.
 - .2 Cutting Metal: Machine square ends, without burrs; bevel ends to produce smooth rigid hairline joints where exposed.
 - .3 Railing Materials: Fabricate decorative metal railing materials straight and true, without scratches, grind marks, creases, and other surface blemishes.
 - .4 Structural Infill Panels: Fabricate infill panels to appear visually flat; cut laminated and tempered glass to final size and shape before heat treatment; provide for proper edge clearance and bite on glass.
-

- .5 Shop Assembly:
 - .1 Pre-assemble decorative metal railings before shipping to greatest extent possible to minimize field splicing and assembly.
 - .2 Disassemble units only as necessary for shipping and handling limitations.
 - .3 Clearly mark units for re-assembly and for coordination with shop drawings.
 - .4 Ship finished materials with protective coverings.

2.3 SOURCE QUALITY CONTROL

- .1 Tests: Conduct testing in accordance with ASTM E2353 and provide written report indicating the following:
 - .1 Static Strength.
 - .2 Impact Performance.
 - .3 Post Breakage Retention Characteristics.
 - .4 Include detailed description of:
 - .1 Bill of Materials.
 - .2 Assembly drawing with glazing details.
 - .3 Performance level and load used.
 - .4 Statement by test method as to the performance of the glass rail, guard or balustrade specimen(s).
 - .5 Method of installation or installation fastening used.
 - .6 Test methods used; with results indicated as pass or fail; numeric values are not required for precision or bias measurements.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine areas to receive structural metal railings and note conditions that adversely affect installation or subsequent use of decorative railing system; coordinate with Contractor for correction of unacceptable site conditions.
- .2 Starting work by this Section will signify acceptance of conditions.

3.2 INSTALLATION

- .1 Install decorative metal railings in accordance with manufacturer's written instructions and reviewed shop drawings, and as follows:
 - .1 Install decorative metal railings plumb, level, square, true to line, and rigid.
 - .2 Fit exposed connections to form tight, hairline joints.
 - .3 Attach decorative metal railings securely in place using anchors and other components supplied or approved by manufacturer.
 - .4 Attach decorative metal railings to supports; ensure exposed surfaces of decorative metal railings are smooth with no sharp, rough, or uneven areas.
 - .5 Do not damage material finishes by welding, cutting, or abrading; do not cut, drill, or alter glass infill panels.
 - .6 Adjust railings before anchoring so that they match alignment at abutting joints.

- .7 Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- .2 Site Tolerances:
 - .1 Variation from Plumb, Posts: Maximum 3 mm in 1 metre.
 - .2 Offset from True Alignment: Maximum 6 mm in 3.6 metres of length, non-cumulative.
 - .3 Align handrails so variations from level for horizontal members and variations from parallel, with rake of steps and ramps for sloping members: Maximum 6 mm in 7.6 metres of length, non-cumulative.

3.3 SITE QUALITY CONTROL

- .1 Tests: Departmental Representative will conduct testing using a third party testing agency in accordance with ASTM E2353 and provide written report indicating the following:
 - .1 Static Strength.
 - .2 Impact Performance.
 - .3 Post Breakage Retention Characteristics.
 - .4 Include detailed description of:
 - .1 Bill of Materials.
 - .2 Assembly drawing with glazing details.
 - .3 Performance level and load used.
 - .4 Statement by test method as to the performance of the glass rail, guard or balustrade specimen(s).
 - .5 Method of installation or installation fastening used.
 - .6 Test methods used; with results indicated as pass or fail; numeric values are not required for precision or bias measurements.
 - .5 Testing will be performed on a sample glass installation consisting of three panels of decorative metal and glass railing system at a location near actual site installed materials.
 - .6 Replace broken or deformed materials resulting from passed tests; reconfigure and retest assemblies resulting from failed tests.

3.4 CLOSEOUT ACTIVITIES

- .1 Adjusting: Repair minor damages to finish in accordance with manufacturer's instructions; replace materials that cannot be satisfactorily repaired.
- .2 Cleaning: Clean decorative metal railings promptly after installation in accordance with manufacturer's instructions.
- .3 Protection: Protect installed decorative metal railings from damage during construction.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O80 Series-R2012, Wood Preservation.
 - .3 CSA O80.27-1.1-08, This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes.
 - .4 CSA O121-08, Douglas Fir Plywood.
 - .5 CSA O141-05(R2009), Softwood Lumber.
 - .6 CSA O151-09, Canadian Softwood Plywood.
 - .7 CAN/CSA-O325.0-07(R2012), Construction Sheathing.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber December 2010.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 LUMBER MATERIAL

- .1 Lumber: unless specified otherwise, softwood, S4S, S-DRY Lumber graded and stamped in accordance with following standards:
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- .1 CSA-O141.
- .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers: to NLGA 113d. and 121c., S4S.
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 Post and timbers sizes: "Standard" or better grade.

2.2 PANEL MATERIALS

- .1 Douglas fir plywood to CSA O121, Sheathing Grade square edges.
 - .1 Urea-formaldehyde free.
- .2 Canadian softwood plywood (CSP): to CSA O151, Class II.
 - .1 Urea-formaldehyde free.
- .3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.
 - .1 Urea-formaldehyde free.
- .4 Plywood: Exterior Rated, Sheathing Grade square edged Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or CSA O151.

2.3 ACCESSORIES

- .1 Nails, spikes and staples: to CSA B111.
- .2 Nails, Brads and Staples: Steel nails meeting requirements of CSA B111, length to penetrate connecting solid wood materials and as follows:
 - .1 Exterior Work: Hot dipped galvanized
 - .2 Interior High Humidity Work: Hot dipped galvanized
 - .3 Interior Work: Electroplated zinc plated or cadmium plated
 - .4 Pressure Treated Materials: Stainless steel
- .3 Rough Hardware (Bolts, Nuts and Washers): Provide fasteners of size and type required for installation and as follows:
 - .1 Ground Contact Materials: Stainless steel
 - .2 Exterior Work: Hot dipped galvanized
 - .3 Interior High Humidity Work: Hot dipped galvanized
 - .4 Interior Work: Electroplated zinc plated or cadmium plated
 - .5 Pressure Treated Materials: Stainless steel
- .4 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:
 - .1 Exterior Work: Galvanized, ceramic coated or stainless steel
 - .2 Interior Work: Galvanized

2.4 FINISHES

- .1 Galvanizing: to ASTM A123/A123M, use galvanized fasteners for exterior work, interior highly humid areas.

- .2 Stainless steel: use stainless steel.

2.5 WOOD PRESERVATIVE

- .1 Surface-applied wood preservative: clear or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.
- .2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.
- .3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.
- .4 Site Applied Wood Preservative: Treatment manufacturer's required preservative wood treatment for touching up and repairing wood products, meeting requirements of CSA O80 series of standards, compatible with pressure preservative treated materials.

Part 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- .1 Comply with requirements of NBC, Division B, supplemented by the following paragraphs.
- .2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.
- .7 Install sleepers as indicated.
- .8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.
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- .9 Site Waste Reduction and Management: Select lumber sizes to minimize waste, reuse scrap lumber to the greatest extent possible and as follows:
- .1 Use scrap lumber for non-critical locations such as shims, bracing and blocking.
 - .2 Do not leave any wood, shavings, sawdust, and similar components, on the ground or buried in fill; prevent sawdust and wood shavings from entering the storm drainage system.
 - .3 Do not burn scraps that have been pressure treated; do not send pressure treated lumber to recycling centres, cogeneration facilities or waste-to-energy facilities.
 - .4 Do not burn waste lumber on site.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

3.4 SCHEDULES

- .1 Provide fire retardent treated electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate
- .2 Electrical equipment mounting boards:
 - .1 Plywood, DFP, G1S grade, square edge, 19 mm thick sanded to Table E.1.
 - .2 Fire retardant treated to CSA O80.27, maximum flame spread 25, maximum smoke developed 25.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/NPA A208.1-09, Particleboard.
 - .2 ANSI/NPA A208.2-09, Medium Density Fiberboard (MDF) for Interior Applications.
 - .3 ANSI/HPVA HP-1-04, Standard for Hardwood and Decorative Plywood.
 - .2 ASTM International
 - .1 ASTM D2832-92(R2005), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
 - .2 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
 - .3 ASTM E1333-10, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
 - .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC), Architectural Woodwork Institute (AWI) and Woodwork Institute (WI).
 - .1 AWI/AWMAC/WI Architectural Woodwork Standards, AWS Edition 1-2009.
 - .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
 - .5 CSA International
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.4 SERIES-M1977(R2006), Standards for Wood Adhesives.
 - .3 CSA O121-08, Douglas Fir Plywood.
 - .4 CSA O141-05, Softwood Lumber.
 - .5 CSA O151-09, Canadian Softwood Plywood.
 - .6 CSA O153-M1980(R2008), Poplar Plywood.
 - .7 CAN/CSA-Z809-08, Sustainable Forest Management.
 - .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .7 International Organization for Standardization (ISO)
 - .1 ISO 14040-2006, Environmental Management-Life Cycle Assessment - Principles and Framework.
 - .2 ISO 14041-98, Environmental Management-Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.
 - .8 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).
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- .9 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 1998.
- .10 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .3 Indicate materials, thicknesses, finishes and hardware.
 - .4 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit duplicate samples of laminated plastic for colour selection.
 - .4 Submit duplicate samples of laminated plastic joints, edging, cutouts and post formed profiles.
 - .5 Submit duplicate samples of solid surfacing including edging as detailed.
- .4 Certifications: submit AWMAC GIS certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Architectural woodwork shall be manufactured and/or installed to the current AWMAC Architectural Woodwork Standards and shall be subject to an inspection at the plant and/or site by an appointed AWMAC Certified Inspector.
 - .2 Inspection costs shall be included in the bid price for this project. Contact your local AWMAC Chapter for details of inspection costs.
 - .3 Shop drawings shall be submitted to the AWMAC Chapter office for review before work commences.
 - .4 Work that does not meet the AWMAC Architectural Woodwork Standards, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to the Departmental Representative.
 - .5 If the woodwork contractor is an AWMAC Manufacturer member in good

standing, a two (2) year AWMAC Guarantee Certificate will be issued.

- .6 The AWMAC Guarantee shall cover replacing, reworking and/or refinishing any deficient architectural woodwork due to faulty workmanship or defective materials supplied by the woodwork contractor, which may appear during a two (2) year period following the date of issuance.
- .7 If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the Departmental Representative with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of the architectural woodwork contract.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
 - .1 Protect millwork against dampness and damage during and after delivery.
 - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .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 architectural woodwork from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Unless otherwise indicated grade of architectural woodwork shall be "Premium".
 - .2 Use clean stock for each type of woodwork and quality grade specified in accordance with AWMAC Manual.
 - .3 Furring, Blocking, Shims, and Hanging Strips: Fire retardant treated softwood or hardwood lumber, kiln dried to less than 15% moisture content.
 - .4 Anchors: Select material, type, size, and finish required for each substrate for secure
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anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 LUMBER MATERIALS

- .1 Non-Exposed Softwood: Meeting CAN/CSA O141, kiln dried to maximum moisture content of 12%, dressed 4 sides.

2.3 PANEL MATERIALS

- .1 Decorative Hardwood Plywood: Meeting CSA O115, AWMAC Manual and as follows:
 - .1 Flitch Selection: Walnut, quarter cut, stained to match submitted sample.
 - .2 Face Veneer: A and Paint grade veneer grade in accordance with Veneer Grades listed in AWMAC Manual, and as selected by Departmental Representative.
 - .3 Refer to Section Finish Legend on Drawings for lists of materials.
- .2 Straw Based Particleboard: Meeting ANSI 208.1 Grade M-3 for interior use, minimum 720 kg/m³ (45l/ft³) density; clearly mark panels with grade mark 'M-3':
- .3 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Premium Grade for interior use, minimum 750 kg/m³ (47lb/ft³) density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m²/m³ (0.13 ft²/ft³) of room volume.
- .4 Fire Retardant Treatment for MDF (where required): Treat MDF with latex fire resistant coating; prime MDF as recommended by coating manufacturer.
- .5 Softwood Plywood: Meeting CSA O121 or CSA O151, cross-banded, sanded G2S, thickness as indicated.
- .6 Hardboard: Meeting CAN/CGSB-11.3, Type 2, minimum density 500 kg/m³ (33lb/ft²), tempered hardboard (Masonite), 6 mm (1/4") nominal thickness unless noted otherwise, one face smooth finish; colour as selected by Consultant from manufacturer's full range.
- .1 Solid Surfacing Sheet: Cast, nonporous, filled polymer, with through body colour meeting requirements of NEMA LD 3, and having the following nominal properties:
 - .1 Thickness: Refer to details on Drawings
 - .2 Surface Burning Characteristics: in accordance with CAN/ULC S102 and as follows:
 - .1 Flame Spread: Maximum 25
 - .2 Smoke Developed: Maximum 25
 - .3 Pattern and Colour: As indicated in Finish Legend.

2.4 LAMINATED FINISHES

- .1 High Pressure Decorative Laminate (HPDL): Meeting CAN3 A172 or ANSI/NEMA LD3 composed of phenolic resin impregnated Kraft paper filler stock for Class 1 Decorative Laminate of Grade required by woodwork quality standard; colour through as described in Section Materials and Finishes Legend and as follows:
 - .1 Self-Edging Work: General Purpose Grade, HGS standard duty.

- .2 Liner Sheet Work: Same as for self-edging work.
- .3 Backing Sheet Work: BKL backing material, thickness as recommended by manufacturer to prevent warpage of surfaces, sanded on one side; furniture finish, solid white colour.
- .2 Low Pressure Decorative Laminate: minimum 0.5 mm (0.020") low pressure decorative laminate having a decorative paper facer thermally fused to low VOC emission/low formaldehyde emission particleboard or MDF core, meeting the requirements of ANSI/NEMA LQ1 – Decorative Boards, colour as indicated in Materials and Finishes Legend.
- .3 Adhesives:
 - .1 Decorative laminate: polyvinyl acetate or aliphatic resin in accordance with manufacturers recommendation for curing under pressure for bonding to wood cores, water resistant type.
 - .2 Edge banding: Thermoplastic hot melt, synthetic resin suitable for applying thin veneer wood edge banding and film overlays.
- .4 Submittals: Submit samples of high and low pressure laminate for consultant's review prior to fabrication.

2.5 CABINET WORK HARDWARE

- .1 Provide the following cabinet hardware, in quantity required and as required, complete with all screws, bolts, washers for complete installation.
- .2 Fasteners:
 - .1 Draw Bolt Fasteners: Mitre butt joint fastener, adjustable and requiring no special tools for installation, galvanized.
 - .2 Non-exposed Fasteners: Fabricators choice consistent with quality level specified.
 - .3 Exposed Fasteners: Architectural appearance, material, finish and
- .3 Pulls: Stainless steel, sizes/profiles to be selected.
- .4 Drawer Slides: Following list of drawer slides is provided to indicate general conformance requirements only; notify the Consultant where drawer width, height or intended use differs from that indicated in the general descriptions and the requirements of the manufacturer; coordinate sample submittals before ordering materials:
 - .1 Low height drawers (≤ 150 mm (6")): Full extension, length to suit drawer box, 22 kg (50 lb) capacity, side mounting with positive stop and hold-in detent features, black zinc finish.
 - .2 High height drawers (≥ 150 mm (6"), ≤ 305 mm (12")): Full extension, Drawer box; Length to suit drawer box, 45 kg (100 lb) capacity, side mounting with positive stop, hold-in detent and silencer features, black zinc finish.
 - .3 File drawers: Require heavy-duty type, specify whether lateral sliding or conventional, include for file support rails.

- .5 Hinges:
 - .1 Typical Cabinet Doors: Concealed, euro-style hinge with cover caps; fully adjustable for overlay, depth, height and closing force; opening angle of 110°; self-closing feature; nickel plated steel construction; overlay and half overlay mounting, size and profile to suit cabinet construction.
 - .2 Typical lockable drawers: Nickel finished, Master Keyed, keyed alike in groups, drawer lock, gang lock for groups of 3 drawers or more.
- .6 Door Latches:
 - .1 Standard Doors: Elbow Latches for inactive leaves of pairs of doors to be locked, standard duty, zinc finish.
- .7 Shelf Rests:
 - .1 Wall Standards and Brackets: Recessed mounted pilaster with clips, chrome finish; space standards at 406 mm o/c, refer to Drawings for number of shelves and length.
 - .2 Wall Shelf Supports: Chrome standard and brackets: Wall shelving, depths as indicated.
- .8 Computer Accessories:
 - .1 Grommets for electrical cords through counter tops.

2.6 ANCILLARY MATERIALS

- .1 Sealant: 1 part silicone to CAN/CGSB-19.13, non-staining, mould and mildew resistant, colour: clear, refer to Section 07 92 00.
- .2 Glass: Tempered glass, thickness indicated as specified, refer to Section 08 80 50.
- .3 Spacers: Rigid PVC to size and profile indicated.
- .4 Hardware: Bolts, nuts, washers, screws, etc., all hot dip heavy zinc-coated.

2.7 CABINET WORK

- .1 Cabinet work shall conform to AWMAC Manual as applicable, premium grade construction.
- .2 Cabinet work for High and low Pressure Laminate Finish:
 - .1 AWMAC Quality Grade Premium.
 - .2 Construction: Cabinetwork shall conform to AWMAC Manual. Flush overlay.
 - .3 Exposed Parts: MDF or Particleboard as specified above.
 - .4 Finishing Exposed Parts: laminate, Wood veneer as indicated in Finishes and Materials Legend on Drawings.
 - .5 Semi-Exposed Parts: MDF or Particleboard core.
 - .6 Finish to Semi-Exposed Parts: decorative laminate selection.

- .7 Concealed parts: Low pressure Plastic Laminate.
- .8 Countertops and backsplashes at sinks and “wet areas” shall be shop sanded exterior grade veneer core plywood, no exceptions.
- .3 Edge Banding shall be in accordance with the AWMAC Manual, decorative laminate for decorative laminate surfaces, except for countertops that shall be as follows.
 - .1 Laminate Countertops and Backsplashes:
 - .1 Countertops and backsplash shall be self-edge type to AWMAC Manual and as modified by this specification for edge sealing and cut-outs for sinks.
 - .2 Laminate: high pressure decorative laminate as indicated on drawing, edging as indicated on drawings and as follows:
 - .3 Self Edge: Decorative laminate to match countertop and backsplash.
 - .2 Backsplash shall conform to AWMAC Details, Site Installed in accordance with AWMAC Manual.

2.8 CABINET FABRICATION

- .1 General
 - .1 All cabinet doors and drawer fronts shall be flush overlay system.
 - .2 Fabricate gables and edges meeting walls oversize to allow for scribing to fit on site.
 - .3 Assemble all Work with flush butt hairline corners and joints. Cut-outs for all services shall be done on site during installation.
 - .4 Joints to be carefully fitted, coped or mitred and securely adhered. There shall be no end wood visible on finished surfaces.
 - .5 Set nail heads in finished surfaces. Countersink screws and bolts, except those detailed to be exposed, and fill holes with edge grain wood plugs to match colour and grain.
 - .6 Do not hardwood edge fibreboard.
 - .7 Ensure adjacent part of continuous laminate work match in colour and pattern.
 - .8 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths of greatest practical length. Keep joints 610 mm (24”) from sink cutouts.
 - .9 Form shaped profiles and bends as indicated, using post-forming grade laminate-to-laminate manufacturer’s instructions.
 - .10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20°. Do not mitre laminate edges.
 - .11 Construction
 - .12 Minimum core thicknesses as follows (unless otherwise indicated on Drawings):
 - .1 Drawer fronts and Doors: MDF 19 mm (3/4”), Particleboard 19 mm (3/4”).
 - .2 Drawer bottoms: MDF 12 mm (1/2”) or plywood 4.7 mm (3/16”).

- .3 Doors: 19 mm (3/4") MDF.
- .4 Drawer sides/fronts/back: MDF/ Particleboard 16 mm (5/8");
- .5 Lower case backs: MDF/ Particleboard 6 mm (1/4");
- .6 Upper (wall) case backs, MDF 12.7 mm (1/2");
- .7 Countertop cores: Wet areas: exterior grade veneer core plywood or phenolic resin particleboard 28.5 mm (1 1/8") and MDF 35 mm (1 3/8") elsewhere.
- .8 Backsplash cores: 19 mm (3/4") plywood or MDF to match countertop core;
- .9 Sliding doors, 3 mm (1/8") tempered hardboard with decorative laminate both sides.
- .10 All other work MDF, 19 mm (3/4").
- .13 Glue, dowel, mortise, lock joint or dado all cabinetwork and cabinet work. Do not use staples. Nailing and screws are acceptable. Do not surface nail or screw through countertops.
- .14 Blocking, framing, web frames to be solid lumber.
- .15 Provide solid wood edge strips in all doors and cases to receive hardware. Rebate and pressure glue to core.
- .16 Cut and adapt all Work to receive hardware. Install all finishing hardware and fittings in shop. Fittings which may be susceptible to damage during shipping and installation may be installed after millwork installed on site.
- .17 MDF countertop and backsplash cores in all areas except for exterior grade veneer core plywood or phenolic resin particleboard cores at sink locations as noted, coordinate with rough-in requirements for sinks. Seal and make waterproof all exposed surfaces of core where cut for sinks are made, unsealed surfaces will cause rejection of all material.
- .18 Screws, for use at site in assembly of securing removable skirts to cabinets: Cadmium plated round-head wood screws, Robertson head 4 mm minimum shank diameter, all one size. Cadmium plated cup washers.

2.9 SIOLID SURFACING FABRICATION

- .1 Fabricate units to maximum size capable of being safely transported and handled to place of final installation in accordance with shop drawing and manufacturer's written instructions using a fabricator certified by the manufacturer.
- .2 Fabricate and machine shapes to profiles indicated on Drawings; obtain all dimensions affecting fabrication and installation from job site before starting fabrication.
- .3 Cut, drill and shape fabrications as required to receive plumbing fittings and services, and built-in accessories, provide edge treatments, back splashes, and other details as indicated on Drawings.
- .4 Finish edges and surfaces true, level and even with inconspicuous joints between having no voids formed using manufacture's standard joint adhesive and reinforcing strips.
- .5 Make cut outs with 3 mm radius corners to prevent stress cracking.
- .6 Fabrication assemblies with tolerances as follows:
 - .1 Variation in component size: ± 3 mm.

- .2 Location of openings: \pm 3 mm from indicated location.
- .7 Match numbered components assembled on site; number items to show proper location on site; number on back using material that will not show or telegraph through finished assemblies.
- .8 Provide anchorage to receive Work of other Sections scheduled and detailed to be installed.

2.10 FACTORY FINISHING – CABINET WORK

- .1 Factory finish cabinet work as follows:
 - .1 Finishes shall be applied in accordance with the AWMAC Manual.
 - .2 All surfaces (both exposed, semi-exposed and unexposed) to be shop decorative laminate faced, wood veneer faced as indicated.
 - .3 Pressure-apply decorative laminate to smooth sanded and cleaned core material with proper adhesives and methods, in accordance with the decorative laminate manufacturer's written instructions.
 - .4 Decorative laminate backing sheet in all cases where facings applied.
 - .5 Melamine is not acceptable and will be rejected.
- .2 Labelling: classified as to surface burning characteristics as follows:
 - .1 Flame spread: 25.
 - .2 Smoke developed: 50.
 - .3 Fuel contributed: 50.
 - .4 Finish as indicated below.

2.11 FINISHING

- .1 Finish in accordance with Division 09.

Part 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Do architectural woodwork to AWI/AWMAC/WI Architectural Woodwork Standards.
- .2 Install prefinished millwork at locations shown on drawings.

- .1 Position accurately, level, plumb straight.
- .3 Fasten and anchor millwork securely.
 - .1 Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00.
- .7 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .8 Install at location where indicated.
- .9 Site apply laminated plastic to units as indicated.
 - .1 Adhere laminated plastic over entire surface.
 - .2 Make corners with hairline joints.
 - .3 Use full sized laminate sheets.
 - .4 Make joints only where indicated.
 - .5 Slightly bevel arises.
- .10 For site application, offset joints in plastic laminate facing from joints in core.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
 - .1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.
 - .2 Remove excess glue from surfaces.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Electrical Isolation: Application of suitable liquid applied weatherproof insulating materials, membrane materials or non-conductive sheets to isolate roofing membranes from direct electrical paths to ground.
- .2 Overburden: Any material placed above roofing membranes as a part of system construction in the form of vegetated roofs and similar components that could create a direct electrical path to ground.

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA):
 - .1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning Work of this Section, with roofing contractor's representative and Departmental Representative in accordance with Section 01 31 19.
- .2 Coordination: Coordinate requirements affecting electronic leak detection system installation including; but are not limited to, the following:
 - .1 Membrane Roofing: Requirements for membrane material composition, condition of membrane required for testing, and minimum acceptable conditions for preliminary roofing testing
 - .2 Roofing Flashings: Requirements for electrical isolation of metal flashings, vent stacks and other elements that contact overburden placed above membranes
 - .3 Roofing Accessories: Requirement for non-conductive vents, pipes, supports and similar membrane penetrations; or electrical isolation of metal components that contact overburden placed above membranes
 - .4 Extent of Membrane: Extend membrane above overburden to eliminate unintentional electrical paths to ground
 - .5 Projections through Membrane: Requirements for electrical isolation of concrete walls and curbs from overburden placed over membranes
 - .6 Condition of Membrane: Requirements for membrane cleanliness, free from stored construction materials, equipment and debris that could affect performance of testing procedures
 - .7 Wiring and Cabling: Requirements for power connections, conduit and wiring for installation of permanent monitoring equipment

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00.

- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data describing premanufactured components being used for the project including; but not limited to, the following:
 - .1 Event sensors
 - .2 Data collectors
 - .3 Data analyzer
 - .4 Data connection to monitoring centre
 - .2 Shop Drawings: Submit shop drawings in identical scale used for project documents indicating; but not limited to, the following:
 - .1 Location and layout of leak detection grid and leads
 - .2 Location of access enclosure
 - .3 Location of wiring path from leak detection grid and leads to access enclosure
 - .4 Wiring diagram of termination block and D-SUB connector used for data collection and analyzer interface
 - .5 Location and size of roof penetrations
 - .6 Location of roof drains and details of electrical guard circuits surrounding drains
 - .7 Sequence of installation and operations
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Preliminary Leak Detection Testing: Submit completed membrane survey report indicating results of preliminary leak detection testing and confirmation that system is functional immediately following installation of membranes including; but not limited to, the following:
 - .1 Identify date, time and weather conditions that survey was performed
 - .2 Describe scanning equipment and process used to perform leak detection testing
 - .3 Describe membrane breach locations
 - .4 Identify areas not accessible by scanning equipment
 - .5 Include photographs, scale plans and drawings indicating locations of breaches

1.5 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Survey Agency for Preliminary Leak Detection: Use survey company certified by leak detection equipment manufacturer having a minimum of three 3 years experience with requirements of this Section, and having similar extent and complexity.
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1.6 SITE CONDITIONS

- .1 Ambient Conditions: Perform preliminary leak detection survey during weather conditions acceptable to electronic leak detection system manufacturer, after membrane system is properly wetted and cleaned.

1.7 WARRANTY

- .1 Manufacturer Warranty: Provide manufacturer's standard two (2) year warranty for leak detection system components stating that roofing system repairs and replacement of defective components will be performed as required in the event of a failure of installed electronic leak detection system.

Part 2 Products

2.1 MATERIALS

- .1 Leak Detection Tape: High dielectric, self adhering moisture detecting tape as recommended by manufacturer to meet system design and installation requirements.
- .2 Access Enclosure: Hinged enclosure cover fabricated from stainless steel, lockable in closed and open position having a NEMA 4, water and dust tight enclosure rating in accordance with NEMA 250 suitable for outdoor use and sized to accommodate test panel, circuit boards, D-SUB connector terminals, barrier blocks and detection grid wiring, and site testing access.
- .3 Electrical Conduit and Cable: Provide electrical cable and connections in accordance with Division 26, in configurations and sizes required to meet system design and installation requirements.

2.2 EQUIPMENT

- .1 Electronic Equipment and Accessories: Include remote measuring units, on site data processing unit, connections to remote monitoring centre, and other components required for a complete and operational leak detection system.
- .2 Survey Equipment: Leak detection system manufacturer's recommended electric gradient leak locator or vertical surface leak locator equipment to perform preliminary leak detection survey after installation of specified membrane system.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that surfaces that leak detection tapes are installed are acceptable before beginning of installation of products specified in this Section and as follows:
 - .1 Verify that membranes and penetrations are non-conductive or are electrically isolated by application of required insulating materials.
 - .2 Verify availability of hose and water supply.
 - .3 Installation of products specified in this Section will denote acceptance of site conditions.

- .2 Preliminary Leak Detection Survey: Perform membrane integrity survey immediately after membrane is installed using manufacturer recommended membrane surveyor including; but not limited to, the following locations:
 - .1 Horizontal membrane surfaces
 - .2 Vertical membrane surfaces including inside and outside corners of parapets, curbs and walls
 - .3 Submit written report of preliminary leak detection survey as required by this Section

3.2 INSTALLATION

- .1 Install permanent electronic leak detection materials and components in accordance with manufacturer's written instruction and reviewed shop drawings.

3.3 CLOSEOUT ACTIVITIES

- .1 Start-Up: Perform system start-up in accordance with manufacturer's recommended procedures as required by Section 01 77 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Work of this section includes, but is not limited to supply and installation of Crystalline Waterproofing applied to the surface of concrete substrates, at the following locations:
 - .1 Dry side of elevator pits

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C39/C39M-12, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - .2 ASTM C 267-01 (2006), Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes
 - .3 ASTM E 329-08, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- .2 United States Army Corps of Engineers Specifications:
 - .1 COE CRD-C 48 - Standard Test Method for Water Permeability of Concrete; 1992.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meetings: Arrange a pre-construction meeting in accordance with Section 01 31 19 – Project Meetings, prior to commencement of installation of materials specified in this section. Purpose of meeting, as follows:
 - .1 Establish procedures to maintain required working conditions.
 - .2 Coordinate work of related and adjacent work.
 - .3 Review substrate conditions
 - .4 Review manufacturer's warranty requirements
 - .5 Verify manufacturer's current installation requirements and recommendations match final waterproofing details required for site.
- .2 Required personnel, as follows:
 - .1 Departmental Representative
 - .2 Waterproofing installer
 - .3 Manufacturer's authorized representative
 - .4 Contractor
 - .5 Subcontractors responsible for work penetrating waterproofing and work adjacent to waterproofing

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
-

- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data, with complete general and specific installation instructions, recommendations, and limitations affecting installation.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical requirements; and that waterproofing system and components; and drainage and protection materials are supplied by a single source manufacturer.
 - .2 Submit written certification that installer has current approved applicator status with waterproofing material manufacturer.
 - .2 Site Quality Control Submittals: Submit written report summarizing manufacturer's observations, and indicating results of final inspection and any corrective action required for changes arising from deficiencies or site conditions.

1.5 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: A firm with not less than ten (10) years experience manufacturing crystalline waterproofing of the type specified, able to provide test reports showing compliance with specified performance characteristics, and able to provide on-site technical representation to advise on installation.
- .2 Installer Qualifications: Experienced in work of the type specified in this section and approved in writing by waterproofing manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials in factory sealed and labelled packaging, and as follows:
 - .1 Sequence deliveries to avoid delays and to minimize on site storage.
 - .2 Handle and store following manufacturer's instructions, recommendations and material safety data sheets.
- .2 Storage and Handling Requirements: Store and handle materials in accordance with manufacturer's instructions, and as follows:
 - .1 Do not double stack pallets during shipping or storage.
 - .2 Protect waterproofing materials from moisture, excessive temperatures and sources of ignition.
 - .3 Provide cover to top, bottom and sides for materials stored on site, allowing for adequate ventilation.
 - .4 Protect from construction operation related damage, damage from weather, excessive temperatures and prolonged sunlight.
 - .5 Remove damaged material from site and dispose of in accordance with applicable regulations.

1.7 SITE CONDITIONS

- .1 Ambient Conditions: Perform work only when existing and forecasted weather conditions are within guidelines established by the manufacturer for installation of waterproofing materials.
- .2 Do not install waterproofing materials where standing or ponding water conditions occur.

1.8 WARRANTY

- .1 Manufacturer Warranty: Provide manufacturer's written system warranty for a period of two (2) years starting from substantial performance of the Project, covering materials and labour.
- .2 Manufacturer's warranty shall be independent from, and run concurrently with, any other warranties for the Contract.
- .3 Installer Warranty: Provide warranty signed by installer that includes the following requirements:
 - .1 Installer warrants that, upon completion of the work, surfaces treated with crystalline waterproofing will be and will remain free of water leakage resulting from defective workmanship or materials for a period of two (2) years from Date of Substantial Performance.
 - .2 In the event that water leakage occurs within the warranty period from such causes, the installer shall, at his own expense, repair, replace, or otherwise correct such defective workmanship and materials.
 - .3 Installer shall not be liable for consequential damages.
 - .4 Installer's liability shall be limited to repair, replacement, or correction of defective workmanship and materials.
 - .5 This warranty excludes leaks or other defects due to causes beyond the installer's control, including but not limited to structural failure, movement of the structure, fire, earthquakes, tornadoes, and hurricanes.

Part 2 Products

2.1 MATERIALS

- .1 Waterproofing Products: Provide installed products that comply with following, when tested using cured concrete samples made without admixtures, with two 1 mm thick coats of waterproofing:
 - .1 Penetration: At least 50 mm penetration of crystal-forming material, evidenced by scanning electron microscope photographs.
 - .2 Permeability: No measurable leakage through waterproofed concrete, when tested in accordance with COE CRD-C 48 at 123.4 m of head or 1200 kPa using 50 mm thick, 13.8 MPa compressive strength concrete.
 - .3 Chemical Resistance: No detrimental effects when tested using 27.6 MPa compressive strength concrete in accordance with ASTM C 267 using hydrochloric acid (pH of 3.5), brake fluid, transformer oil, ethylene glycol, toluene, and caustic soda as test mediums for duration of 84 days each; 14 % increase minimum in concrete compressive strength when tested in accordance with ASTM C 39/C 39M.
 - .4 Potable water
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- .2 Waterproofing: Two-coat crystalline waterproofing.
 - .1 First Coat: Slurry proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve specified coverage with application method used.
 - .2 First Coat Coverage: Thickness and density as recommended by manufacturer
 - .3 Second Coat Coverage: Thickness and density as recommended by manufacturer
 - .4 Second Coat: Proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve full coverage with application method used.
- .3 Top-of-Slab Waterproofing: Dry shake powder application on fresh concrete; proprietary compound of Portland cement, silica sand and various active chemicals, formulated as a powder compound for dry shake application.
- .4 Dry Pack Repair Compound: Dry pack consistency mixture of Xypex Concentrate; proprietary compound of Portland cement, silica sand and active chemicals; and water in proportions recommended by manufacturer.
- .5 Patching Compound: Single component, fast-setting, nonshrink, high bond strength hydraulic cement; with admixture where needed for increased bond strength to existing concrete.
- .6 Slurry Coat: Slurry proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve the specified coverage with application method used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
- .2 Obtain waterproofing manufacturer's approval of substrate conditions; submit site inspection report.
- .3 Do not install unless substrate and ambient air temperature are within range acceptable to waterproofing manufacturer.

3.2 NEWLY PLACED HORIZONTAL CONCRETE SURFACES

- .1 Comply with manufacturer's product data sheets, technical bulletins, and installation instructions.
- .2 Apply rough wood float or broom finish.
- .3 Apply dry shake powder to fresh horizontal concrete surfaces at rate recommended by manufacturer. Incorporate powder into surface during concrete finishing process.

3.3 PREPARATION OF CURED CONCRETE

- .1 Prepare surfaces being treated in accordance with waterproofing manufacturer's instructions.
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- .2 Clean laitance, curing compounds, excess form oil, dirt film, paint, coatings or other foreign matter harmful to performance of waterproofing from surfaces of cured concrete being treated.
- .3 Prepare cured surfaces if necessary to provide open capillary surface; use acid etching, sandblasting, water blasting, or other methods as recommended by manufacturer.
- .4 Defects: Rout out defects, such as cracks, faulty construction joints, honeycombing, form tie holes, and other defects to sound concrete, and repair.
 - .1 Chip defective areas into a U-shaped slot 25 mm wide and minimum 25 mm deep.
 - .2 Clean slot, wet, saturate with water and remove surface water.
 - .3 Apply specified slurry coat to slot at rate recommended by manufacturer.
 - .4 Allow slurry coat to reach initial set.
 - .5 Fill cavity with specified dry pack repair compound.
 - .6 Compress tightly into cavity using pneumatic packer or hammer and blocks.
- .5 Rock Pockets, Honeycombing, and Other Defective Concrete:
 - .1 Rout out defective areas to sound concrete.
 - .2 Remove loose material and saturate with water.
 - .3 Remove surface water and apply specified slurry coat.
 - .4 After slurry coat has set, but while still green, fill cavity to surface with specified patching compound.
- .6 Coves: At right-angle intersections cove joint for smooth transition of waterproofed surface.
 - .1 Apply specified slurry coat to slot at rate recommended by manufacturer.
 - .2 Fill and form surfaces using specified dry pack repair compound or waterproofing material in mortar consistency while slurry coat is still green, but after slurry coat has reached initial set.
 - .3 Trowel into cove shape.
- .7 Construction Joints: Apply sealing strips at each construction joint by filling grooves coinciding with construction joint.
 - .1 If grooves have not been preformed, at least 19 mm (3/4 inch) wide and minimum 25 mm (1 inch) deep, saw cut and chip grooves to that dimension.
 - .2 Apply specified slurry coat to slot at rate recommended by manufacturer.
 - .3 Fill and form surfaces using specified dry pack repair compound while slurry coat is still green, but after slurry coat has reached initial set.
 - .4 Compact tightly using pneumatic packer or hammer and block.

3.4 APPLICATION ON CURED CONCRETE

- .1 Comply with manufacturer's instructions, including product data, technical bulletins, catalogue installation instructions, and product carton instructions.
 - .2 Mix materials in accordance with manufacturer's instructions.
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- .3 Wet concrete surfaces and saturate with clean water to ensure migration of crystalline chemicals into concrete; remove free surface water before application of waterproofing treatment.
- .4 Exposed Surface Application: Apply waterproofing uniformly with semi-stiff bristle brush or spray under conditions and application rate recommended by manufacturer.
- .5 Apply second coat while first coat is still green, but after reaching initial set.
- .6 Use light pre-watering between coats when rapid drying conditions occur.
- .7 Curing: Cure exposed waterproofing treatment using a mist fog spray of clean water after coating has hardened sufficiently not to be damaged by spray; do not use plastic sheeting laid directly on waterproofing; air circulation is required.
 - .1 If water curing is not possible, follow manufacturer's recommendations for curing using chemical curing agent approved by manufacturer.
 - .2 Avoid coating damage with spray operation.
 - .3 Spray treated surface 3 times a day for 2 to 3 days.
 - .4 In hot climates, spray treated surfaces at intervals recommended by waterproofing manufacturer.
 - .5 During curing period, protect treated surfaces from rainfall, ambient temperature below freezing, and puddling of water.
 - .6 Provide supplementary air circulation as recommended by waterproofing manufacturer.
- .8 Comply with waterproofing manufacturer's recommendations for sequencing construction operations after waterproofing applications to avoid conditions detrimental to performance of waterproofing application.

3.5 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.
- .2 Do not cover waterproofed surfaces with other construction until they have been observed by manufacturer's site representative and Departmental Representative.

3.6 CLEANING AND PROTECTION

- .1 Clean spillage and overspray from adjacent surfaces using appropriate cleaning agents and procedures.
- .2 Protect installed product from damage during construction; do not allow traffic on unprotected waterproofed surfaces.
- .3 Do not backfill against waterproofed surfaces for at least 36 hours after installation; use moist backfill material when backfilling occurs less than 7 days after installation.
- .4 Do not apply paint or other coatings for at least 21 days; before applying coatings neutralize waterproofed surface as recommended by waterproofing manufacturer.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - .2 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .3 ASTM E96-10/E96M-10, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 Canadian Standards Association (CSA).
 - .1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
 - .2 CAN/CSA-B149.2-05, Propane Storage and Handling Code.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 71-GP-24M-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .4 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
 - .2 CAN/ULC S702.2-10, Mineral Fibre Thermal Insulation for Buildings

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's insulation products and adhesives.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
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- .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 for recycling in accordance with Waste Management Plan.

Part 2 PRODUCTS

2.1 INSULATION

- .1 Foundation Wall Insulation: Closed cell extruded polystyrene foam insulation manufactured in accordance with CAN/ULC S701:
 - .1 Type: 4
 - .2 Compressive strength: Minimum compressive strength 210 kPa at 10% deformation in accordance with ASTM D1621
 - .3 Thickness: As indicated
 - .4 Edges: Square
- .2 Perimeter Insulation: Premanufactured concrete faced extruded polystyrene foam insulation manufactured in accordance with CAN/ULC S701:
 - .1 Type 4
 - .2 Compressive Strength: Minimum compressive strength 240 kPa at 10% deformation in accordance with ASTM D1621
 - .3 Thickness: As indicated
 - .4 Edges: Tongue and groove edges along long edges; butt edges along short edges
 - .5 Topping: 8 mm thick latex modified concrete topping, grey coloured with broom textured finish
- .3 Wall Insulation: Fibrous mineral insulation manufactured in accordance with CAN/ULC S702:
 - .1 Type: 1
 - .2 Density: Minimum nominal density 70 kg/m³ in accordance with ASTM C612
 - .3 Thickness: As indicated
 - .4 Edges: Square

2.2 ADHESIVE

- .1 Adhesive (for polystyrene): to CGSB 71-GP-24.

2.3 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 WORKMANSHIP

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

3.3 EXAMINATION

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

3.4 RIGID INSULATION INSTALLATION

- .1 Apply adhesive to the substrate by the "dab" method not less than 10 mm x 20 mm size at 150 mm centres; bed the insulation in the adhesive before the adhesive loses its tack or skins over.

3.5 PERIMETER FOUNDATION INSULATION

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

3.6 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .2 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .3 ASTM C297/C297M-04(2010), Standard Test Method for Flatwise Tensile Strength of Sandwich Construction.
 - .4 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .5 ASTM D968-05(2010), Standard Test Methods for Abrasion Resistance of Organic Coatings by the Falling Abrasive.
 - .6 ASTM D2247-11, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - .7 ASTM E72-10, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - .8 ASTM E96/E96M-12, Standard Test Methods for Water Vapor Transmission of Materials.
 - .9 ASTM E2098/E2098M-13, Standard Test Method for Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution.
 - .10 ASTM E2134-01(2006), Standard Test Method for Evaluating the Tensile-Adhesion Performance of an Exterior Insulation and Finish System (EIFS).
 - .11 ASTM E2321-03(2011), Standard Practice for Use of Test Methods E96/e96M for Determining the Water Vapor Transmission (WVT) of Exterior Insulation and Finish Systems (EIFS).
 - .12 ASTM E2430/E2430M-13, Standard Specification For Expanded Polystyrene (EPS) Thermal Insulation Boards For Use In Exterior Insulation and Finish Systems (EIFS).
 - .13 ASTM G154-12a, Standard Practice for Operating Fluorescent Light Apparatus UV Exposure of Nonmetallic Materials.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
 - .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S716.1-12, Standard For Exterior Insulation and Finish Systems (EIFS) - Materials and Systems.
 - .2 CAN/ULC-S716.3-12, Standard For Exterior Insulation and Finish Systems (EIFS) - Design Application.
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- .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 EIFS Industry Members Association (EIMA)
 - .1 EIMA 101.03-95, Standard Adhesion Strength.
 - .2 EIMA 105.01-95, Standard Test Method for Alkali Resistance of Glass Fibre Reinforcing Mesh for Use in EIFS.
 - .3 EIMA 101.86-95, Standard Test for Impact Resistance.

1.2 DEFINITIONS

- .1 Aesthetic joint: joint for appearance of installation ease. Also known as aesthetic reveals, grooves and reglets used to provide starting and stopping points during application of finish coat.
- .2 Adhesive: a polymer based, polymer modified or cementitious material, typically mixed with Portland cement used to attach insulation board to substrate.
- .3 Back wrapping: at edges (termination) of EIFS where the reinforcing mesh and base coat extend from the back side of the insulation around the termination edge and onto the front of the insulation.
- .4 Base coat adhesive: adhesive used in base coat.
- .5 Base coat: layer consists of polymer modified, typically mixed with Portland cement and applied to face of insulation board and reinforced with one or more layers of mesh to function as a weather barrier.
- .6 Base coat thickness: greater than 3 mm.
- .7 Expansion joint: joint through EIFS to allow for movement.
- .8 Finish coat: acrylic-based, decorative and protective coating applied to outside surface of base coat.
- .9 Lamina: base coat, reinforcing mesh and finish.
- .10 Mechanical fastener: mechanical device for attaching insulation to substrate.
- .11 Reinforcing mesh: balanced, open weave, glass fibre reinforcement to base coat providing impact resistance.
- .12 Substrate: surface to which EIFS is attached.

1.3 SYSTEM DESCRIPTION

- .1 Exterior insulation and finish system to be a site applied cladding system consisting of adhesive, insulation board, base coat with reinforcing mesh and finish.
 - .1 Adhesive applied.

1.4 PERFORMANCE REQUIREMENTS

- .1 Installed modified polymer coat wall system to have following performance properties:
 - .1 Comply with CAN/ULC-S134.
 - .2 Comply with CAN/ULC S716.1
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- .3 Finish-abrasion resistance: falling sand method to ASTM D968, no deleterious effects.
- .4 Finish-salt spray resistance: to ASTM B117, after 300 hours' exposure to 5% salt spray solution - no effects.
- .5 Finish-moisture resistance: to ASTM D2247 (U.S. Federal Test Standard 141A Method 6201), after 14 days exposure - no deleterious effects.
- .6 Accelerated weathering: to CAN/CGSB-1.162.
- .7 Impact resistance: to ASTM E72, only slight dents observed up to 108.465J.
- .8 Bond strength: to ASTM E2098.
- .9 Permeability: to ASTM E96/E96M.

1.5 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit product data in accordance with Section 01 33 00.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS acceptable to Labour Canada, and Health and Welfare Canada for exterior insulation and finishing materials. Indicate VOC content.
 - .3 Submit product data sheets for system materials. Include product characteristics, performance criteria, limitations and colours.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Indicate wall layout, details, connections, expansion joints, finish system, installation sequence, including interface with doors, windows, air barriers, vapour retarders and other components.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00.
 - .2 Submit one 300 x 300mm sample of each colour of finished wall system.
- .5 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.
- .6 Manufacturers' Field Reports: submit copies of manufacturers field reports, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installation of exterior insulation and finish wall system by applicators certified by manufacturers of system used.
 - .2 Submit certification to Departmental Representative prior to commencement of work in accordance with 01 33 00.
 - .2 Convene pre-installation meetings: one week prior to beginning work of this Section.
-

- .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordinate with other building subtrades.
 - .4 Review manufacturer's instructions and warranty requirements.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00.
- .2 Deliver and store materials in accordance with manufacturer's instructions.
- .3 Protect adhesives and base finish materials from freezing.
- .4 Store and protect insulation from physical damage and direct exposure to weather.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20, and with the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Plan and coordinate insulation work to minimize generation waste. Minimize cutoffs, collect return to manufacturer and recycling.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with the Waste Management Plan.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Use the least toxic sealants, adhesives, sealer and primers necessary to comply with requirements of this section.
- .8 Close and seal, tightly, all partly used sealant and adhesive containers and store protected in well ventilated, fire-safe area at moderate temperature.
- .9 Place used hazardous sealant tubes and adhesive containers in areas designated for hazardous materials.

1.9 PROJECT/SITE ENVIRONMENTAL REQUIREMENTS

- .1 Ambient Conditions: Install materials only when temperature range is between the minimum and maximum allowable by manufacturer; provide supplemental heat or shading where temperature on surface is outside of permitted range; maintain temperature of surfaces within allowable range during and for a period of 24 hours after installation.

Part 2 PRODUCTS

2.1 SURFACE PREPARATION

- .1 Conditioner: water base, clear conditioner/sealer compatible with system materials, recommended by system manufacturer.
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- .2 Leveler: polymer-modified, cement-based, reinforced leveling compound.

2.2 ADHESIVES

- .1 Polymer-modified cement-based, reinforced adhesive.

2.3 MECHANICAL FASTENERS

- .1 Framing Fasteners: Corrosion resistant stainless steel screw or impact type fastener of type and size to suit substrate and having high density polypropylene or polyethylene plastic washers minimum 50 mm in diameter with nib to encapsulate screw head.
- .2 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, 2.5 mm annealed steel spindle, length to suit insulation, 25 mm diameter self locking washers.

2.4 INSULATION

- .1 Moulded (expanded) polystyrene (EPS): to CAN/ULC-S701, Type 1, RSI as indicated.

2.5 BASECOAT

- .1 Test adhesive base coat to: ASTM C297.
- .2 Modified polymer, cementitious base coat system: Portland cement, silica sand aggregate, acrylic liquid admixture, 13.2% acrylic to cement ratio.

2.6 REINFORCING MESH

- .1 Reinforcing mesh: to ASTM E2098.
- .2 Balanced, non-woven glass fiber fabric made from twisted multi-end strands, treated, alkali resistant, compatible with chemical bonding system base coat and finish coat, weight intermediate - 380 g/m².
- .3 Specialty mesh:
 - .1 Detail mesh: flexible, symmetrical, woven glass fiber fabric made from twisted multi-end strands, treated, alkali resistant, compatible with chemical bonding system base coat and finish coat, weight 153 g/m².
 - .2 Corner mesh: precreased, non-woven glass fiber fabric made from twisted multi-end strands, treated, alkali resistant, compatible with chemical bonding system base coat and finish coat, weight 212 g/m².

2.7 FINISH COAT

- .1 Modified polymer finish coat system: acrylic resins in dispersion, silica aggregate, integral mineral pigmentation and additives, colour selected by Departmental Representative.
 - .1 Texture: Fine sand float

2.8 PRIMER

- .1 Acrylic based primer.
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2.9 ACCESSORIES

- .1 Accessories: galvanized corner beads, casing beads, stop beads, starter strips and accessories, as recommended by exterior insulated wall system manufacturer to suit system components.

2.10 EXPANSION JOINTS

- .1 Expansion joints: PVC.
- .2 Ensure expansion joints are back wrapped.
- .3 Joint Cleaner: non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .4 Sealant primer: as recommended by sealant manufacturer.
- .5 Joint filler: extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 - 200 kPa, oversized 30 to 50%.
- .6 Joint Sealant: Low modulus, non-sag, long service life sealant and backer rod system meeting requirements of ASTM C1481, as required by manufacturer for system installed and as specified in Section 07 92 00, and as follows:
 - .1 Weather seals: multi-component, chemical curing to CAN/CGSB-19.24, Type 2, Class B.
 - .2 Panel joints: multi-component, chemical curing to CAN/CGSB-19.24, Type 2, Class B.
 - .3 Colour: To match adjacent materials

2.11 MATERIALS: SITE MIX

- .1 Cement: to CAN/CSA-A3001.
- .2 Sand: dry bag.
 - .1 For white cement: silica sand, 30-50 mesh.
 - .2 For grey cement: mortar sand to ASTM C144.
- .3 Water: potable.

2.12 MIXES

- .1 General:
 - .1 Mixer: high speed, clean and rust free.
 - .2 Mixing pail: clean and rust free.
 - .3 Mixes: additive free.
 - .2 Conditioner: mix in accordance with manufacturer's written instructions.
 - .3 Leveler: mixed to a uniform consistency in accordance with manufacturer's written instructions.
 - .4 Adhesive: mixed in accordance with manufacturer's written instructions.
 - .5 Basecoat: mixed to uniform consistency in accordance with manufacturer's written instructions.
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- .6 Finish coat: mixed to uniform consistency in accordance with manufacturer's written instructions.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Inspect and verify condition of existing substrate surfaces for contamination, surface absorption, chalkiness, cracks, damage, deterioration, moisture content, moisture damage, and tolerances. Substrate tolerance in accordance with manufacturer's written instructions.
- .2 Report deviations from specified requirements or other conditions that might adversely affect EIFS installation in writing to Departmental Representative.
- .3 Proceed with Work only after receipt of written approval from Departmental Representative.

3.2 PREPARATION

- .1 Protection
 - .1 Protect adjacent surfaces from damage resulting from Work of this section.
 - .2 Protect finished Work from water penetration at end of each day or on completion of each section of Work.
 - .3 Protect installation from moisture for 48 hours minimum after completion of each portion of Work.
 - .4 Protect top of parapet walls, and openings until flashings and trim, are installed.
- .2 Surface preparation
 - .1 Ensure environmental and site conditions are suitable for installation of system.
 - .2 Prepare new surfaces in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- .1 Install system in accordance with CAN/ULC-S134, ASTM C1397 and EIFS manufacturer's written instructions; mix materials and additives only as specifically required or as directed by EIFS manufacturer.
 - .2 Surface preparation:
 - .1 Conditioner: water base, clear conditioner/sealer compatible with system materials, substrate and as recommended by system manufacturer.
 - .1 Add water and mix.
 - .2 Apply to clean, dry substrate surfaces ensuring complete even coverage in accordance with manufacturer's written instructions.
 - .2 Leveler: Polymer-modified, cement based, reinforced leveling compound.
 - .1 Add water and mix.
 - .2 Allow set time.
 - .3 Apply to existing substrate, 6 mm thick maximum.
 - .4 Allow time to fully cure as outlined in manufacturers written instructions.
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- .3 Insulation anchors: install insulation anchors to spacing and pattern recommended by EIFS manufacturer. Maintain continuity of air barrier system.
 - .4 Adhesives application and installation of insulation board:
 - .1 Apply uniform ribbons of adhesive to back of and parallel to long dimension of insulation board, using recommended notched trowel.
 - .2 Offset insulation joints.
 - .3 Immediately place insulation boards in running bond pattern on walls with long dimension horizontal, starting from level base line. Apply firm pressure over entire surface of board to ensure full contact. Determine location and pattern of sheathing joints. Bridge sheathing joints by minimum of 200 mm.
 - .4 Butt vertical and horizontal joints tightly together. Ensure joints between boards are free of adhesive.
 - .5 Cut insulation board in L-shaped pattern to fit around openings. Do not align joints with corners of openings.
 - .6 Remove individual boards periodically when adhesive is still wet to check for satisfactory contact with substrate and back of insulation board.
 - .5 Backwrapping:
 - .1 Ensure edge of insulation board is wrapped with base coat prior to installation to substrate.
 - .2 Apply strip of detail mesh with adhesive to substrate at level base line and at terminations.
 - .3 Ensure width of detail mesh is adequate to adhere 100 mm of mesh onto substrate and to wrap around insulation board edge with minimum 64mm coverage on outside of insulation board.
 - .4 After adhering detail mesh to substrate ensure, mesh ends hang free for completion of backwrapping procedure after insulation application.
 - .6 Accessories:
 - .1 Install all required accessories as detailed and as required by EIFS manufacturer and in accordance with CAN/ULC-S134.
 - .7 Preparation of insulation board surface:
 - .1 Fill open joints in insulation board with slivers of insulation or spray foam as recommended by manufacturer's written instructions.
 - .2 Rasp surface to achieve smooth, level, even surface after insulation boards have firmly adhered to substrate. Remove ultraviolet ray damage. Rasp smooth any irregularities in insulation board greater than 1.6 mm. Ensure insulation board tolerance in accordance with manufacturer's written instructions.
 - .8 Joints:
 - .1 Reveals and Aesthetic Grooves: Confirm locations of details and aesthetic joints with Departmental Representative before cutting in or placing and as follows:
 - .1 Cut reveals and aesthetic grooves with appropriate tool in locations indicated.
 - .2 Offset reveals minimum 75 mm from insulation joints.
-

- .3 Maintain minimum 19 mm insulation board thickness at bottom of groove after cutting.
- .4 Cut in v-grooves and reveals as indicated on Drawings; provide functional grooves to account for system workability and building movements; provide drip edges to soffit areas and other overhanging details.
- .2 Expansion joints
 - .1 Where substrate has control joint, expansion joint or live building crack
 - .2 Where EIFS coating is applied over dissimilar substrates
 - .3 Install drainage flashing sealed to substrate at expansion joints and fire control breaks.
- .9 Backwrapping completion:
 - .1 Complete backwrapping procedure by applying base coat to exposed edges of insulation board and 100 mm onto face of insulation board.
 - .2 Pull mesh tight around board and embed it in base coat with trowel.
 - .3 Use corner trowel for clean, straight lines.
 - .4 Smooth wrinkles or gaps in mesh.
- .10 Mesh and base coat application:
 - .1 Apply 225 x 300 mm diagonal strips of detail mesh at corners of windows, doors and penetrations through insulation. Embed strips in wet base coat and trowel from centre to mesh edge to avoid wrinkles.
 - .2 Apply detail mesh at reveals. Embed mesh in wet base coat and trowel from base of reveal to mesh edges.
 - .3 Apply corner mesh at inside and outside corners. Embed mesh in wet base coat and trowel from corner of mesh edges.
 - .4 High impact mesh application: Apply base coat over insulation board to uniform thickness of approximately 3 mm. Work horizontally or vertically in 1000 mm strips, and immediately embed mesh into wet base coat by troweling from centre to edge of mesh. Butt mesh at seams. Allow base coat to dry.
 - .5 Standard mesh application:
 - .1 Apply base coat over insulation board, including areas with high impact mesh to uniform thickness of approximately 3 mm.
 - .2 Work horizontally or vertically in 1000mm strips, and immediately embed mesh into wet base coat by troweling from centre to mesh edge.
 - .3 Overlap mesh 64 mm minimum at mesh seams and overlaps of detail mesh.
 - .4 Feather seams and edges.
 - .5 Double wrap inside and outside corners with minimum 64mm overlap in each direction. Embed corner mat in wet base coat, allow to dry, then overlap up to corner with standard reinforcing mesh embedded in base coat.
 - .6 Avoid wrinkles in mesh.
 - .7 Fully embed mesh so that no mesh colour shows through base coat when dry.

- .8 Ensure minimum base coat thickness 1.6 mm when dry. Re-skim base coat if 1.6 mm thickness not achieved during initial application. Allow base coat to thoroughly dry before applying primer or finish coat.
- .6 Apply additional layer of high impact reinforcing mesh into wet basecoat and allow a minimum of 24 hours to cure before applying standard reinforcing mesh in a second basecoat layer, and as follows:
 - .1 Butt high impact reinforcing mesh tightly; do not overlap.
 - .2 Set high impact reinforcing mesh up to edges of corners and aesthetic reveals; do not run high impact reinforcing around corners or through aesthetic reveals
 - .3 Do not double wrap corners where high impact reinforcing mesh is used; use preformed high impact corner mesh where available from EIFS manufacturer.
 - .4 High Impact Zones (0 to 2400 mm high): Heavy Duty Mesh
 - .5 Corner and Butterfly Zones: Intermediate Duty Mesh
- .11 Finish coat application:
 - .1 Apply finish coat in accordance with manufacturer's writing installation instructions.
 - .2 Prime dry base coat and allow to dry thoroughly before applying finish coat.
 - .3 Apply finish coat directly over base coat, or primed base coat, only after base coat or primer has thoroughly dried.
 - .4 Apply finish by spray or trowel as recommended by manufacturer.
 - .5 Apply finish in continuous application, and work towards wet edge.
 - .6 Do not install separate batches of finish coat side by side.
 - .7 Do not apply finish into or over sealant joints. Apply finish to outside of wall only.
 - .8 Do not apply finish over irregular or unprepared surfaces.
 - .9 Apply textured or aggregate finishes to wall areas as indicated and in accordance with manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturers' field services:
 - .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
 - .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

.4 Obtain reports within three days of review and submit.

3.5 CLEANING

.1 Upon completion of installation, remove excess materials, droppings and debris, tools and equipment barriers. Clean adjacent surfaces.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing of Materials:
 - .1 ASTM D146-04 (2012)e1, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
 - .2 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
 - .3 ASTM E96/E96M-10, Standard Test Methods for Water Vapor Transmission of Materials
 - .4 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 - .5 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials
 - .6 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- .2 Canadian General Standards Board:
 - .1 CAN/CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with manufacturers and installers for installation procedures of materials incorporated into air and vapour membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide two copies of most recent technical air and vapour membrane components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .4 Manufacturer's field report: in accordance with Section 01 45 00.

1.4 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturer: Obtain air and vapour membrane materials through one source from a single manufacturer or using materials from a secondary source that are acceptable to the manufacturer.

- .2 Installer: Use an installation company that is acceptable to the manufacturer, using workers who are trained and approved by the membrane manufacturer having experience with projects of similar complexity and area.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to job site in original unopened packages, clearly marked with manufacturer's name, material brand name and description of contents.
- .2 Storage and Handling Requirements: Protect membrane materials before, during and after installation in accordance with manufacturer's requirements for weight, temperature, heat and flame, and humidity; store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by membrane manufacturer.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: Apply air and vapour membrane to substrate surfaces that are within manufacturer's installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching manufacturer's minimum temperature threshold.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Provide materials and installations that meet the following material and assembly performance ratings, and as follows:
 - .1 Material Performance: Provide materials having an air permeance rating not exceeding 0.02 l/sec-m^2 measured at 75 Pa pressure differential in accordance with ASTM E2178; and having a vapour permeance rating not exceeding 3.5 g/sec-m^2 in accordance with ASTM E96.
 - .2 Assembly Performance: Install materials and accessories to provide a continuous air and vapour membrane assembly having an air leakage rate not exceeding 0.20 l/sec-m^2 measured at 75 Pa pressure differential in accordance with ASTM E2357; that will perform as the primary drainage plane flashed to direct condensation or water penetration to the exterior; that will accommodate movement of building materials and building expansion and contraction; and that has appropriate accessory materials to account for changes in substrate, transitions and other perimeter conditions.
 - .3 Low Temperature Performance: Modify acceptable material listings and provide manufacturer's low temperature or ultra-low temperature membrane products when installation conditions are scheduled to occur at or below installation temperature range of specified materials.

2.2 AIR AND VAPOUR MEMBRANE ASSEMBLY

- .1 Primers and Undercoats: Manufacturer's recommended primer or surface conditioner to improve bond between membranes to substrates.

- .2 Self Adhering Membrane: Self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:
 - .1 Low Temperature Flexibility: Less than -20°C
 - .2 Nominal Thickness: 1.5 mm
- .3 Through Wall Flashing Membranes: Self adhering SBS modified bitumen reinforced membrane with cross-linked polyethylene skins, specifically manufactured for use as through wall flashing or dampproofing course; and having the following nominal properties:
 - .1 Service Temperature Range: -40°C to +80°C
 - .2 Thickness: 1.0 mm

2.3 ACCESSORIES

- .1 Panel Sheathing Tape: Manufacturer's recommended self adhering tape compatible with liquid applied air and vapour membranes specified in this Section.
- .2 Roof-to-Wall Transition Membranes: Manufacturer's recommended reinforced self adhesive, compatible with roofing air and vapour membranes and wall materials specified in this Section.
- .3 Opening Transition Membranes: Manufacturer's recommended reinforced, self adhesive membrane compatible with adjacent materials, and air and vapour membranes specified in this Section.
- .4 Through Wall Membranes: Manufacturer's recommended reinforced self adhesive, compatible with air and vapour membrane and that will not become plastic and extrude onto finished surfaces when exposed to high wall temperatures.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine conditions of substrates and other conditions affecting this Section before starting work; notify other related trades and verify that substrates are complete and ready for installation of products specified in this Section.

3.2 PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris and as follows:
 - .1 Exterior Gypsum Sheathing Panels: Verify that boards are sufficiently stabilized with corners and edges fastened with appropriate screws; pre-treat board joints with reinforced self adhesive tape or fibreglass mesh tape; fill gaps wider than 6 mm with mastic or sealant and allow sufficient time to fully cure before applying tape and liquid applied membrane.
 - .2 Adjacent Materials: Treat construction joints and install flashings as recommended by manufacturer.

- .2 Apply primer to substrates when required by manufacturer at rate recommended by manufacturer; cover primed substrates on same day, reapply primer when work cannot be completed on the same day.

3.3 INSTALLATION

- .1 Install air and vapour membranes in accordance with manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:
 - .1 Holes and Tears: Repair holes and tears with compatible membrane materials; overlap affected surface area by a minimum of 100 mm and seal edges of repair with manufacturer's recommended mastic material.
 - .2 Transition Membranes: Connect air and vapour membranes to adjacent assemblies having pre-installed transition membranes at openings and other assemblies; install transition membranes where required to maintain continuity of building envelope.
 - .3 Corner Details and Protrusions: Cover inside corners and protrusions, centred and installed in direct contact with the substrate with no voids under the membrane strip; reinforce outside corners by double lapping or stripping as required by membrane manufacturer.
 - .4 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.
- .2 Separate air and vapour membranes from incompatible materials, and provide manufacturer's recommended transition materials required to maintain continuity of building envelope.
- .3 Inspect membrane installation at end of each day of work and before installation of insulation; seal upper edge of membrane with mastic at end of day's work when precipitation is anticipated or when work is expected to be delayed or interrupted by more than one day.

3.4 SITE QUALITY CONTROL

- .1 Allow access for inspection and testing of installed air and vapour membranes, and repair of deficiencies before placement of insulation materials.
- .2 Manufacturer's Site Services: Arrange for air and vapour membrane manufacturer's technical personnel to review building envelope during installation as follows:
 - .1 Provide training and supervision of personnel who will install membrane systems and coordinate other subcontractors affected by work of this Section
 - .2 Provide frequent visits during the progress of the work to assure quality and competence of membrane installation in accordance with manufacturer's instructions
 - .3 Verify surface conditions prior to installation to
 - .4 Verify that workmanship requirements are being met during installation and to provide technical assistance and installation guidance as necessary to ensure a complete and continuous membrane assembly
 - .5 Verify that installation meets requirements of manufacturer's warranty after completion of membrane system
 - .6 Submit written report of site activities, directions for correction of installed membranes, detailing and any special installation requirements resulting from site conditions different than manufacturer's standard details

- .3 Non-Conforming Work: Repair or replace non-conforming work at no additional expense to the Project.

3.5 CLOSEOUT ACTIVITIES

- .1 Protection: Protect membrane as recommended by manufacturer from effects of long term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with manufacturer's written instructions using original installers.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM E1643-10, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
 - .2 ASTM E1745-09, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.2 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Limitations
- .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Quality assurance submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Laboratory Test Results: submit full set of actual test results as per paragraph 8.3 of ASTM E1745 (including all after conditioning permeance tests).
 - .3 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Store materials in a clean, dry area in accordance with manufacturer's instructions.
- .3 Stack membrane on smooth ground or wood platform to eliminate warping.
- .4 Protect materials during handling and application to prevent damage or contamination.
- .5 Ensure membrane is stamped with manufacturer's name, product name, and membrane thickness.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Product not intended for uses subject to abuse or permanent exposure to the elements.
 - .2 Do not apply on frozen ground.
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Part 2 PRODUCTS

2.1 SHEET VAPOUR BARRIER

- .1 Plastic Vapour Barrier: Vapour Barrier membrane must have the following properties:
 - .1 Permeance as tested after conditioning (ASTM E 1745 paragraphs 7.1.2 - 7.1.5): less than 0.01 perms (gr/ft²/hr/in-Hg).
 - .2 Strength: Class A, ASTM E 1745.
 - .3 Minimum thickness: 0.38 mm (15 mils).

2.2 ACCESSORIES

- .1 Seam tape: high-density polyethylene film and a rubber-based, pressure-sensitive adhesive, specially designed to seal seams and penetration, approximate width 100 mm, by vapour barrier manufacturer.
- .2 Pipe Boots: Where slab penetrations occur, construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.
- .3 Vapour-Proofing Mastic: use mastic provided by vapour barrier manufacturer.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examine surfaces to receive membrane. Notify Departmental Representative if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Level and tamp or roll aggregate.

3.3 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of vapour barrier.
- .2 Install in accordance with manufacturer's instructions and ASTM E1643.
- .3 Unroll vapour barrier over the entire area where the slab is to be poured. Unroll vapour barrier with the longest dimension parallel with the direction of the pour. Completely cover concrete placement area.
- .4 Lap vapour barrier over footings and seal to foundation walls.
- .5 Overlap all joints 150 mm and seal with manufacturer's tape.
- .6 Seal all penetrations (including but not limited to pipes, ducting, rebar) with manufacturer's pipe boot, or tape and mastic.
- .7 No penetration of the vapour barrier is allowed except for reinforcing steel and permanent utilities.

- .8 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed. Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 150mm. Clean all adhesion areas of dust, dirt and moisture. Tape all four sides with tape.
- .9 Do not proceed until repair work has been inspected and approved by Departmental Representative.

3.4 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of factory formed, site assembled, non-structural, concealed fastener, insulated architectural standing seam metal roofing system; including accessories required for weather tight installation; job site manufactured materials will not be acceptable for this project.
- .2 Drawings indicate size, profiles, and dimensional requirements of metal roofing system and are based on the specific system indicated; do not modify intended aesthetic effects.

1.2 DEFINITIONS

- .1 Metal Roofing System Assembly: Metal roofing system, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather tight roofing system.
- .2 Core Metal Thickness: Minimum thickness of base metal without metallic coatings or painted finishes.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-10, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, Physical (Structural) Quality
 - .2 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 20M-08, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications
 - .3 Canadian Standards Association (CSA):
 - .1 CSA CAN/CSA S16-01, Limit States Design of Steel Structures
 - .2 CSA S136-94 (R2001), Cold Formed Steel Structural Members
 - .4 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.108-M89, Bituminous Solvent Type Paint
 - .5 European Committee for Standardization (CEN):
 - .1 EN 988-1997, Zinc and Zinc Alloys: Specifications for Rolled Flat Products for Building
 - .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA 1793, Architectural Sheet Metal Manual, 6th Edition, 2003
 - .7 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S702-09, Thermal Insulation, Mineral Fibre, for Buildings
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1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 – Project Meetings at project site with Contractor, Subcontractor, and Departmental Representative present before starting roof construction; purpose of meeting is to review methods and procedures related to roof construction and metal roofing system including the following:
 - .1 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - .2 Review methods and procedures related to metal roofing system installation, including manufacturer's written instructions.
 - .3 Examine deck substrate, sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
 - .4 Review structural loading limitations of deck during and after roofing.
 - .5 Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roofing system.
 - .6 Review temporary protection requirements for metal roofing system during and after installation.
 - .7 Review roof observation and repair procedures after metal roofing system installation.
- .2 Coordination:
 - .1 Coordinate metal roofing system with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roofing system and accessory.
 - .2 Shop Drawings: Submit shop drawings indicating fabrication and installation layouts of metal roofing system; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details, identify between factory and site assembled work, include details for the following:
 - .1 Accessory details drawn at minimum 1:10 scale including the following:
 - .1 Flashing and trim
 - .2 Gutters
 - .3 Roof curbs
 - .4 Snow guards

- .3 Samples: Submit two (2) samples for each type of exposed finish required for Consultant's verification of finishes, prepared in sizes as follows:
 - .1 Metal roofing system: 300 mm long by actual panel width; include fasteners, clips, closures, and other metal roofing system accessories.
 - .2 Trim and Closures: 300 mm long; include fasteners and other exposed accessories.
 - .3 Vapour Retarders: 150 mm square samples.
 - .4 Accessories: 300 mm long samples for each type of accessory.
- .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Coordination Drawings: Coordination drawings drawn at minimum 1:100 indicating locations of penetrations and roof mounted items including the following:
 - .1 Roof systems and attachments
 - .2 Roof penetrations
 - .3 Equipment supports
 - .4 Pipe supports and penetrations
 - .5 Snow guards
 - .6 Items mounted on roof curbs

1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturers written maintenance data for metal roofing system, include name of original installer and contact information for inclusion in maintenance manuals in accordance with Section 01 78 00.

1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
 - .1 Manufacturer: Obtain each type of metal roofing system through one source from a single manufacturer.
 - .2 Installer: Use only installers that are trained and qualified by factory formed roofing panel manufacturer, and who have experience in projects of similar complexity and scope.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver components, sheets, metal roofing system, and other manufactured items to prevent damage or deformation; package metal roofing system for protection during transportation and handling.
- .2 Storage and Handling Requirements: Unload, store, and erect metal roofing system in a manner to prevent bending, warping, twisting, and surface damage, and as follows:
 - .1 Protect metal roofing system to prevent wetting of materials, and as follows:
 - .1 Stack metal roofing system on platforms or pallets, covered with suitable weather tight and ventilated covering.
 - .2 Do not store metal roofing system in contact with other materials that might cause staining, denting, or other surface damage.

- .2 Protect strippable protective covering on metal roofing system from exposure to sunlight and high humidity, except to extent necessary for period of metal roofing system installation.
- .3 Protect foam plastic insulation from surface degradation, and as follows:
 - .1 Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - .2 Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 - .3 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.9 SITE CONDITIONS

- .1 Site Measurements: Verify locations of roof framing and roof opening dimensions by site measurements before metal roofing system fabrication and indicate measurements on shop drawings.
- .2 Established Dimensions: Establish framing and opening dimensions and proceed with fabricating metal roofing system without site measurements where site measurements cannot be made without delaying the Work, or allow for site trimming of panels; coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.
- .3 Ambient Conditions: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roofing system in accordance with manufacturers' written instructions and warranty requirements.

Part 2 Products

2.1 STANDING SEAM METAL ROOFING SYSTEM

- .1 Performance Requirements: Provide metal roofing system in accordance with performance requirements specified in this Section and as follows:
 - .1 Design and construct roof so that completed installation will not leak.
 - .2 Design snow fences in accordance with Canadian Building Digest No. 228 - Sliding Snow on Sloping Roofs.
 - .3 Provide maximum deflection not exceeding 1/180 under system weight plus snow load and build-up, and wind and suction loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load for 1:50 years.
 - .4 Provide movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasoned temperature range, from -40°C to +50°C, and preceding noted wind and suction loads.
 - .5 Provide expansion joints to accommodate movement in wall system and between wall system and building structure where these movements are caused by deflection of building structure, without permanent distortion, damage to in-fills, racking of joints, breakage of seals, or water penetration into system.
 - .6 Provide for positive drainage to the exterior of all water entering or condensation occurring within the system.

- .2 Panel Materials: Tension levelled, titanium/zinc alloy sheet in accordance with EN 988 and as follows:
 - .1 Thickness: 0.70 mm base metal thickness and 1.5 mm thick base metal thickness for closures, clips and detailing components; allow for increased thickness as required to meet design loads.
 - .2 Profile: As indicated on Drawings.
 - .3 Finish Designation: Blue-Grey
 - .4 Length: Maximum manufacturer's permitted for installation orientation and exposure
- .3 Ventilation Sheet: Three dimensional, polymer cores; 10 mm nominal thickness as recommended by panel material manufacturer for exposure and loading conditions and as follows:
- .4 Underlay Sheet: Triple layer, spun bonded polypropylene, water resistant and vapour permeable underlayment sheet designed specifically for sloping roof construction; nominal 1.5 metres wide x 50 metres long; coloured black; with system accessories required for complete installation including seam and detail tapes.
- .5 Insulation: Roofing installers choice compatible with manufacturer's recommendations; adjust edge of roof detailing to match modified insulation thicknesses based on required RSI Values indicated on drawings:
 - .1 Mineral Fibre Insulation: To ASTM C726, thickness as required to meet required RSI Value.
- .6 Premanufactured Vapour Retarder: Modified bituminous, self adhering vapour retarder, designed specifically for installation to dry steel decks or gypsum board substrates; width 1140 mm and having a non-slip surface and UV resistant opaque surface:
- .7 Auxiliary Levelling Surface: Gypsum board sheathing: ASTM C1396M roof sheathing material having treated core to provide temporary weather protection during installation, suitable for normal humidity buildings, and as follows:
 - .1 Thickness: As indicated
 - .2 Long Edges: Square.
 - .3 Location: Roof substrates over steel decks only.
- .8 Splice Tapes: Manufacturer's recommended slicing tapes placed within standing seams; as a part of double lock seams.
- .9 Ice and Water Shield, and Detailing Membrane: Self adhering, high temperature resistant high density cross laminated polyethylene back butyl rubber sheet membrane; minimum 0.75 mm thickness.
- .10 Girts: Fabricated from minimum 1.2 mm nominal base metal thickness galvanized steel to ASTM A653M, Grade 230 with Z275 zinc coating.
- .11 Slip Sheet: Same as required for underlay sheet listed above.
- .12 Miscellaneous Metal Framing: Cold rolled steel framing in accordance with CSA S136, and as follows:
 - .1 Steel Sheet Components: Fabricated from 1.2 mm nominal base metal thickness galvanized steel to ASTM A653M, with Z120 zinc coating.

- .2 Hat Shaped, Rigid Furring Channels: Fabricated from 0.72 mm nominal base metal thickness galvanized steel, depth as indicated or detailed.
- .3 Cold Rolled Furring Channels: 1.5 mm nominal bare steel thickness, with minimum 13 mm wide flange, depth as indicated or detailed.

2.2 ACCESSORY MATERIALS

- .1 Provide components required for complete metal roofing system assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items; match material and finish of metal roofing system.
- .2 Fasteners: Self tapping screws, bolts, nuts, self locking rivets and bolts, end welded studs, and other suitable fasteners designed to withstand design loads, and as follows:
 - .1 Provide exposed fasteners with heads matching color of metal roofing system by means of plastic caps or factory applied coating.
 - .2 Fasteners for Roof systems: Self drilling or self tapping, zinc plated, hex head carbon steel screws, with a stainless-steel cap or zinc aluminum alloy head and EPDM or neoprene sealing washer.
 - .3 Fasteners for Flashing and Trim: Blind fasteners or self drilling screws with hex washer head; no exposed fastenings on exposed faces.
 - .4 Blind Fasteners: High strength stainless steel rivets.
- .3 Bituminous Coating: Cold applied asphalt mastic, SSPC-Paint 12, compounded for 0.4 mm dry film thickness per coat; inert type non-corrosive compound free of asbestos fibres, sulphur components, and other deleterious impurities.
- .4 Flashing, Roof Curbs, Gutters, and Trim: Prefinished flashing materials to match roofing materials in accordance with Section 07 62 00.

2.3 FABRICATION

- .1 Fabricate and finish metal roofing system and accessories at the factory to greatest extent possible, using manufacturer's standard procedures and processes to obtain the indicated profiles and meeting dimensional and structural requirements for the Project.
- .2 Fabricate flashing and trim in accordance with SMACNA recommendations that apply to the design, dimensions, metal, and other characteristics of item indicated.

2.4 FINISHES, GENERAL

- .1 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- .2 Variations in appearance of abutting or adjacent pieces are acceptable if they are within ½ the range of reviewed samples:
 - .1 Noticeable variations in the same piece are not acceptable.
 - .2 Variations in appearance of other components are acceptable if they are within the range of reviewed samples and are assembled or installed to minimize contrast.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roofing system supports, and other conditions affecting performance of work.
- .2 Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roofing system manufacturer.
- .3 Examine roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roofing system manufacturer.
- .4 Examine roughing-in for components and systems penetrating metal roofing system to verify actual locations of penetrations relative to seam locations of metal roofing system before metal roofing system installation.
- .5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- .2 Install auxiliary levelling substrate boards over steel deck; attach with mechanical fasteners into top flutes of steel to prevent wind uplift.
- .3 Install flashings and other sheet metal in accordance with requirements specified in Section 07 62 00.
- .4 Install fasciae and copings in accordance with requirements specified in Section 07 62 00.
- .5 Install sub-purlins, eave angles, furring, and other miscellaneous roof system support members and anchorage in accordance with metal roofing system manufacturer's written recommendations.

3.3 INSTALLATION

- .1 Ice and Water Shield: Install self adhering sheet ice and water shield; wrinkle free, on roof sheathing under metal roofing system and as follows:
 - .1 Apply primer if required by manufacturer and install in accordance with temperature restrictions of ice and water shield manufacturer; use primer rather than nails for installing ice and water shield at low temperatures.
 - .2 Apply over entire roof in shingle fashion to shed water, with end laps of not less than 150 mm staggered 600 mm between courses and as follows:
 - .1 Overlap side edges not less than 90 mm
 - .2 Roll laps with roller
 - .3 Cover ice and water shield within 14 days
 - .3 Install flashings to cover ice and water shield in accordance with requirements specified in Section 07 62 00.
 - .4 Apply slip sheet over ice and water shield before installing metal roofing system.
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- .2 Ventilation and Underlay: Install ventilation sheet and underlay in accordance with manufacturer's recommendations; lap breather type building paper underlay in two layers shingled in the direction of roof slope, include starter course and subsequent layers offset by a half lap.
- .3 Thermal Insulation: Extend insulation in thickness required to meet thermal resistance values indicated; cover entire roof in accordance with manufacturer's installation requirements and as follows:
 - .1 Install insulation horizontally and hold in place with Z-shaped furring members spaced 600 mm o/c; securely attach narrow flanges of furring members to roof deck with screws spaced 600 mm o/c.
 - .2 Install second layer perpendicular to first layer with Z-shaped furring members spaced 600 mm o/c; securely attached to top flanges of lower furring members.
- .4 Metal Roofing System: Install metal roofing system in accordance with manufacturer's written instructions and as modified by this Section and as follows:
 - .1 Provide metal roofing system of full length from eave to ridge, unless restricted by shipping limitations.
 - .2 Anchor metal roofing system and other components of the Work securely in place, with provisions for thermal and structural movement:
 - .1 Site cutting of metal roofing system by torch is not permitted.
 - .2 Install panels perpendicular to purlins.
 - .3 Rigidly fasten eave end of metal roofing system and allow ridge end free movement due to thermal expansion and contraction; pre-drill panels before installing fasteners.
 - .4 Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
 - .5 Flash and seal metal roofing system with weather closures at eaves, rakes, and at perimeter of all openings; fasten with self tapping screws.
 - .6 Locate and space fastenings in uniform vertical and horizontal alignment.
 - .7 Install ridge and hip caps as metal roofing system work proceeds.
 - .8 Locate panel splices over, but not attached to, structural supports.
 - .9 Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - .10 Lap or shingle metal flashing under metal roofing system to allow moisture to run over and off the roofing and flashing materials.
 - .3 Use stainless steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
 - .4 Protect against galvanic action where dissimilar metals contact each other or corrosive substrates, by painting contact surfaces with bituminous coating, by applying rubberized asphalt ice and water shield to each contact surface, or by other permanent separation as recommended by metal roofing system manufacturer.

- .5 Install gaskets, joint fillers, and sealants where required for weatherproof performance of metal roofing system; include types of gaskets, fillers, and sealants recommended by metal roofing system manufacturer, and as follows:
 - .1 Seal metal roofing system end laps with double beads of tape or sealant, full width of panel.
 - .2 Seal folded seam laps with double beads of tape or sealant for complete length of folded seam.
 - .3 Seal side joints where recommended by metal roofing system manufacturer.
 - .4 Prepare joints and apply sealants in accordance with requirements in Section 07 92 00.
 - .6 Fasten metal roofing system to supports with concealed clips at each standing seam joint at location, spacing, and with fasteners recommended by manufacturer, and as follows:
 - .1 Install clips to supports with self tapping fasteners.
 - .2 Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - .3 Crimp folded seams with manufacturer approved motorized seaming tool so clip, metal roofing system, and factory applied sealant are completely engaged.
 - .7 Provide metal soffit panels full width of soffits and install panels perpendicular to support framing; flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.
 - .8 Provide bread pan panels at ridges and hips as a part of moisture venting system for installed roofing.
 - .9 Align bottom of fascia panels and fasten with blind rivets, bolts, or self tapping screws; flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- .5 Accessories: Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion; coordinate installation with flashings and other components and as follows:
- .1 Install components required for a complete metal roofing system assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - .2 Install flashing and trim in accordance with performance requirements, manufacturer's written installation instructions, and SMACNA recommendations; provide concealed fasteners where possible, and set units true to line and level; install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - .3 Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
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- .4 Provide for thermal expansion of exposed flashing and trim:
 - .1 Space movement joints at equally spaced intervals to a maximum of 3 metres o/c with no joints allowed within 600 mm of corner or intersection.
 - .2 Form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant concealed within joints where lapped or bayonet type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof.
- .5 Join gutter sections with riveted and soldered, or lapped and sealed joints:
 - .1 Attach gutters to adjacent construction spaced not more than 1200 mm o/c using manufacturer's standard fasteners.
 - .2 Provide end closures and seal watertight with sealant.
 - .3 Provide for thermal expansion.
- .6 Install roof curbs at locations indicated on Drawings; install flashing around bases where they meet metal roofing system.
- .7 Form flashing around pipe penetration and metal roofing system; fasten and seal to metal roofing system as recommended by manufacturer.
- .6 Snow Guards: Install system in accordance with manufacturer's instructions and reviewed shop drawings and as follows:
 - .1 Place clamps as required by in-service loads.
 - .2 Place clamps in straight, aligned rows.
 - .3 Place both set screws on same side of clamp.
 - .4 Tighten set screws to manufacturer's recommended torque. Randomly test set screw torque using calibrated torque wrench.
 - .5 Insert colour matched metal strips into cross members, staggering strips to cover cross member joints.
 - .6 Attach cross members to clamps; tighten bolts to manufacturer's recommended torque.
 - .7 Install splice connectors at cross member end joints.
 - .8 Do not cantilever cross members more than 100 mm beyond last clamp at ends.
- .7 Erection Tolerances: Shim and align metal roofing system units within installed tolerance of 6 mm in 6 metres on slope and location lines as indicated and within 3 mm offset of adjoining faces and of alignment of matching profiles.

3.4 SITE QUALITY CONTROL

- .1 Engage a factory authorized service representative to inspect completed metal roofing system installation, including accessories and to report results in writing to Departmental Representative.
 - .2 Remove and replace applications of metal roofing system where inspections indicate that they do not comply with specified requirements.
 - .3 Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
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3.5 CLEANING AND PROTECTION

- .1 Remove temporary protective coverings and strippable films, if any, as metal roofing system are installed, unless otherwise indicated in manufacturer's written installation instructions.
- .2 Clean finished surfaces as recommended by metal roofing system manufacturer upon completion of metal roofing system installation; maintain in a clean condition during remainder of construction.
- .3 Replace metal roofing system components that become damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-04a, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, Physical (Structural) Quality
- .2 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 20M-99, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications
- .3 Canadian Standards Association (CSA):
 - .1 CSA CAN/CSA S16-01, Limit States Design of Steel Structures
 - .2 CSA S136-94 (R2001), Cold Formed Steel Structural Members
- .4 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.108-M89, Bituminous Solvent Type Paint
- .5 European Committee for Standardization (CEN):
 - .1 EN 988-1996, Zinc and Zinc Alloys: Specifications for Rolled Flat Products for Building

1.2 PERFORMANCE REQUIREMENTS

- .1 Maximum deflection not to exceed $L/180$ under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:50 years.
- .2 Design sheet cladding to span continuously over at least four structural supports (three spans) and design fastening to structural supports to sustain factored loads in accordance with CAN/CSA S136.
- .3 Calculate live load deflections in accordance with CSSBI 20M, as modified by the requirements of this Section.
- .4 Provide for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasonal temperature range from -40°C to $+50^{\circ}\text{C}$, and wind loads noted in 1.2.1 above.
- .5 Include expansion joints to accommodate movement in wall system and between wall system and building structure, where these movements are caused by deflection of building structure, and accommodate these movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .6 Provide for positive drainage to the exterior of all water entering or condensation occurring within the system.
- .7 Final review and acceptance of work completed by this Section shall be carried out by the manufacturer's representative, the Departmental Representative, Contractor and the Subcontractor.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00.
- .2 Submit manufacturer's certification indicating that the installer has been trained and has experience in the installation of zinc cladding materials.
- .3 Submit manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total cladding assemblies.
- .4 Submit shop drawings indicating layouts of claddings, details of corner conditions, joints, deflection joints, cladding profiles, supports, anchorages, trim, flashings, closures, exposed fastener locations, and special details, distinguishing between factory and site assembled work.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .5 Include structural analysis data signed and sealed by a professional engineer responsible for their preparation of shop drawings for installed products indicated to comply with design loadings listed in 1.2 above.
- .6 Submit samples of materials as follows:
 - .1 Provide sample cladding 300 mm long x actual cladding width in specified profile, style, colour, and texture including clips, caps, battens, fasteners, closures, and other exposed cladding accessories for verification and acceptance by the Departmental Representative.

1.4 QUALITY ASSURANCE

- .1 Engage an experienced installer having a minimum of five (5) years experience who has completed metal wall cladding projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance; only installers who are trained and recognized by the zinc cladding manufacturer and who able to provide certification from the manufacturer will be acceptable for work on this project.
- .2 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Document requirements including, but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals requiring structural engineering.
 - .2 Site review of installed components.

1.5 MOCK-UPS

- .1 Provide required Mock-Ups in accordance with Section 01 45 00 – Quality Control.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing wall claddings.

- .3 Build mock-ups to comply with the following requirements, using exposed and concealed materials indicated for the completed Work, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Departmental Representative.
 - .2 Notify Departmental Representative seven (7) days in advance of the dates and times when mock-ups will be constructed.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship, connections and relationship to adjacent materials.
 - .4 Construct mock-up indicating relationship between wall claddings, air spaces, air/vapour retarder membrane, windows, and doors.
 - .5 Obtain Departmental Representative's acceptance of mock-ups before proceeding with construction of wall claddings.
 - .6 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.
 - .7 Acceptable mock-ups in an undisturbed condition at the time of Substantial Performance may become part of the completed Work.
- .4 Departmental Representative will review mock-up and may request minor changes to enhance performance or aesthetic appearance, and as follows:
 - .1 Unaccepted mock-ups shall be removed, repaired, or rebuilt as required to meet project requirements.
 - .2 Installer will be entitled to claim for increased costs where changes requested by Departmental Representative require an additional cost to the system.
 - .3 Costs will not be reimbursable and changes will be made to meet indicated details before acceptance by Departmental Representative where increased costs arise from not following Departmental Representative's design drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials so they will not be damaged or deformed.
- .2 Package materials for protection against damage during transportation or handling.
- .3 Exercise care in unloading, storing, and erecting wall system to prevent bending, warping, twisting, and surface damage.
- .4 Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering, maintaining wall system in a dry condition.
- .5 Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

- .1 Verify location of structural members and openings in substrates by site measurements before fabrication and indicate measurements on shop drawings, coordinate fabrication schedule with construction progress to avoid delaying the work.

- .2 Where site measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating wall system without site measurements or allow for trimming cladding units on site, coordinate wall construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.8 PRE-CONSTRUCTION MEETING

- .1 Arrange a pre-construction meeting in accordance with Section 01 31 19.
- .2 Convene one (1) week before commencing Work of this Section to discuss expectations for fit and finish of wall system, quality of workmanship for installation of air/vapour retarders and insulation and relationship of wall system to adjacent components.
- .3 Meeting shall be attended by the installer, manufacturer's representative, Contractor, Departmental Representative and any other Subcontractors affected by work of this Section.
- .4 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of membrane installation and cladding alignment.

1.9 COORDINATION

- .1 Coordinate work of this section with the requirements of Section 07 62 00 for specific requirements for supply of sheet metal flashing materials to other sections of the work as follows:
 - .1 Supply sheet metal flashings required for the project, regardless of sheet metal thickness and colour.
 - .2 Provide prefinished sheet metal flashings to installing trades, tension levelled and guillotine sheared to length ready for brake forming, fabrication and installation by installing trades.
 - .3 Coordinate with installing trades during bid period and provide unit prices for materials based on specified thickness and colour of flashing materials required under their respective scopes of work; installing trades will be responsible for carrying cost for flashing materials in their scope of work.
 - .4 Requirements of this portion of the scope of work do not apply to extruded aluminum or other pre-manufactured flashing materials normally supplied by installing trades (i.e.: extruded aluminum curtain wall flashing and sills, preformed roof penetrations, non-prefinished sheet metal products).
 - .5 Subcontractor responsible for supply of metal wall cladding will only be responsible for fabrication and installation of flashings relating to their scope of work.

Part 2 Products

2.1 CLADDING MATERIALS

- .1 Zinc Cladding (ZC): Tension levelled, titanium/zinc alloy sheet in accordance with EN 988 and as follows:
 - .1 Thickness: 0.80 mm base metal thickness, or thicker as required to meet design loads; 1.5 mm thick base metal thickness required for window sills.
 - .2 Profile: As indicated on Drawings.
 - .3 Finish: Blue-Grey
 - .4 Length: Maximum 3600 mm

2.2 SYSTEM COMPONENTS

- .1 Wall Cladding Backup:
- .2 Girts: Fabricated from minimum 1.21 mm base metal thickness galvanized steel to ASTM A653, Grade 230 with Z275 (G90) coating; finish material visible after assembly of wall system to match cladding.
- .3 Fabric Underlayment/Slip Sheet: high permeability vapour barrier, spun bonded polypropylene fabric,
 - .1 Thickness: 0.50 mm
 - .2 Tensile strength: 8.2 N/mm
 - .3 Water Vapour Transmission: 212 perms as per ASTM E96, Method B
 - .4 Flame Spread: Class A
 - .5 Smoke Developed: Class A
- .4 Ventilation Sheet: dimpled polyethylene separation membrane.
- .5 Flashing, Trim and Enclosure: Core material, thickness, and finish to match cladding material.
- .6 Horizontal Parapet Joint Counterflash: 200 mm wide corrugated zinc panel with water checks at each edge, of same material as cap flashings.
- .7 Fastenings:
 - .1 Finish all exposed fasteners to match metal claddings; self tapping screws, bolts, nuts, self locking rivets and bolts, end welded studs, and other suitable fasteners designed to withstand design loads; obtain Departmental Representative's acceptance for any exposed fastener locations in advance of installation.
 - .2 Provide metal backed neoprene washers under heads of exposed fasteners located on weather side of claddings.
 - .3 Manufacturer's standard concealed fasteners to suit design loads and application.
 - .4 Fixed Clips for Standing Seam Panels:
 - .1 Type 304 stainless steel clips; 0.4 mm thick clips designed to engage panel edges for profile indicated.
 - .2 Pre-punch clip for attachment into the substrate.
 - .3 Design clip to withstand negative load requirements.

- .5 Expansion Clips for Standing Seam Panels:
 - .1 Same as fixed clips, except as for thickness of fixed base shall be 0.6 mm with 0.4 mm thick sliding component incorporating a 70 mm slot to accommodate movement.
- .6 Fasteners for Standing Seam Clips:
 - .1 Type 304 stainless steel fasteners recommended by manufacturer, and that prevents telegraphing of fastener locations to the panel.
 - .2 Minimum pullout strength: 0.5 kN
- .7 Fasteners for Trim Attachments:
 - .1 Fasteners for Flashing and Trim: Type 410 stainless steel and as follows:
 - .1 Blind fasteners, high strength stainless steel rivets
 - .2 Self drilling screws with pancake head.
- .8 Insulation Fastenings:
 - .1 Corrosion resistant, galvanized bugle head screws with 38 mm diameter washer, 25 mm minimum penetration into wall framing.
- .8 Closure Strips: Closed cell, self extinguishing, expanded, cellular, rubber or cross linked, polyolefin foam flexible closure strips, cut or pre-moulded to match configuration of cladding to maintain weather tight construction.
- .9 Sealing Tape: Pressure-sensitive, 100% solids, polyisobutylene compound sealing tape with release paper backing; permanently elastic, non-sag, non-toxic, non-staining.
- .10 Sealant: One-part elastomeric polyurethane, polysulphide, or silicone rubber sealant as recommended by cladding manufacturer in accordance with Section 07 92 00, type as recommended by manufacturer for specific end use, colour to match cladding where exposed.
- .11 Insulation: As specified in Section 07 21 13.
- .12 Air/Vapour Retarder: As specified in Section 07 25 13.
- .13 Accessories: Provide components required for a complete wall cladding assembly including trim, copings, fasciae, mullions, sills, ventilation strips, corner units, clips, seam covers, flashings, louvres, sealants, gaskets, fillers, closure strips, and similar items; to match materials and finishes of claddings.
- .14 Bituminous Coating: Cold-applied asphalt mastic, in accordance with CGSB 1.108, compounded for 0.40 mm) dry film thickness per coat with inert type non-corrosive compound free of asbestos fibres, sulphur components, and other deleterious impurities.

2.3 SOLDER

- .1 Solder for Zinc: ASTM B32, 60% lead and 40% tin with low antimony, as recommended by manufacturer.
 - .2 Stripping: Manufacturer's recommended stripping agent and flux for removal of coating prior to soldering
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2.4 FABRICATION

- .1 Fabricate and finish cladding, and accessories at the factory to greatest extent possible using manufacturer's standard procedures and processes, and conforming to indicated profiles and with dimensional and structural requirements.
- .2 Fabricate cladding true, plumb and square, with no oil-canning or deformity that detracts from aesthetic appearance, matching quality and installation of accepted mock-up specified.
- .3 Apply bituminous coating or other permanent separation materials on concealed cladding surfaces where cladding will be in direct contact with substrate materials that are not compatible or could result in corrosion or deterioration of either materials or finishes.

Part 3 Execution

3.1 EXAMINATION

- .1 Obtain dimensions from job site before fabricating wall system.
- .2 Examine substrates for conditions affecting performance of metal cladding walls and correct unsatisfactory conditions, or notify Contractor for correction of conditions not controlled by this Section.
- .3 Do not proceed with wall cladding installation until unsatisfactory conditions have been corrected.
- .4 Inspect wall system and components before installation and verify that there is no shipping damage.
- .5 Do not install damaged claddings; repair or replace as required for smooth and consistent finished appearance.

3.2 PREPARATION

- .1 Coordinate metal wall system installation with rain drainage work; flashing; trim; and construction of soffits, roofing, parapets, walls, and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.
- .2 Promptly remove protective film, if any, from exposed surfaces of metal claddings. Strip with care to avoid damage to finish.
- .3 Install girts, angles, and other secondary structural cladding support members and anchorage according to reviewed shop drawings and manufacturer's written instructions.
- .4 Install air and vapour retarder membrane, and insulation in accordance with requirements of Section 07 25 13 and Section 07 21 13.

3.3 CLADDING INSTALLATION

- .1 Comply with cladding manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates.
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- .2 Install wall cladding backup over z-bar supports.
- .3 Install fabric underlayment/slip sheet over wall cladding backup and fasten as recommended by manufacturer.
- .4 Install ventilation sheet under parapet cap flashing.
- .5 Anchor wall system and other components of the work securely in place, with provisions for thermal and structural movement, and as follows:
 - .1 Site cutting exterior cladding by torch is not permitted.
 - .2 Install cladding with concealed fasteners to the maximum extent possible; notify Departmental Representative in advance where exposed fasteners will be required.
 - .3 Install cladding with exposed exterior and interior fasteners, prefinished to match cladding finishes.
 - .4 Locate and space exposed fasteners in true vertical and horizontal alignment.
 - .5 Use proper tools to obtain controlled, uniform compression for positive seal without rupture of neoprene washer.
- .6 Install accessories as required for a complete wall cladding assembly including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items.
- .7 Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of wall cladding assemblies of types indicated or, if not otherwise indicated, types recommended by cladding manufacturer and as follows:
 - .1 Flash and seal cladding at ends and intersections with other materials with rubber, neoprene, or other closures to exclude weather.
 - .2 Seal cladding end laps with a bead of tape or sealant, full width of cladding.
 - .3 Seal side joints where recommended by cladding manufacturer.
 - .4 Prepare joints and apply sealants to comply with requirements of Section 07 92 00.
- .8 Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating or by other permanent separation as recommended by manufacturers of dissimilar metals.
- .9 Installation Tolerances: Shim and align cladding system within installed tolerance of 6 mm in 6000 mm on level, plumb, and location lines as indicated, and within 3 mm offset of adjoining faces and of alignment of matching profiles.

3.4 CLEANING AND PROTECTION

- .1 Damaged Units: Replace cladding and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.
- .2 Cleaning:
 - .1 Remove temporary protective coverings and strippable films, if any, as soon as each cladding is installed.
 - .2 On completion of cladding installation, clean finished surfaces as recommended by cladding manufacturer and maintain in a clean condition during construction.

3.5 SITE QUALITY CONTROL

- .1 Engage a factory authorized service representative to inspect completed metal roofing system installation, including accessories and to report results in writing to Departmental Representative.
- .2 Remove and replace applications of metal roofing system where inspections indicate that they do not comply with specified requirements.
- .3 Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
 - .2 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .3 ASTM D792-00, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- .2 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC S134-92 (R1998), Standard Method of Fire Test of Exterior Wall Assemblies

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate installation of air and vapour retarder membranes and insulation with installation of work of this Section, confirm acceptable substrate and fastening requirements for work of this Section supplied and installed by other Sections.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's standard product data clearly indicating materials used and methods of installation.
 - .2 Shop Drawings: Submit shop drawings indicating attachment methods, joinery, accommodation of thermal movement, edge conditions, panel joints and reveals, fixture locations, anchorages, accessories, finish colours, patterns and textures; prepare detail drawings at a minimum 1:2 scale and elevations at a minimum 1:100 scale, include proof of CAN/ULC S134 testing for rated assemblies.
 - .3 Samples:
 - .1 Samples for Initial Selection: Manufacturer's colour charts or chips showing the full range of colors, textures, and patterns available for wall panels with factory applied finishes.
 - .4 Samples for Verification:
 - .1 Panels: Submit two (2)-300 mm x 300 mm samples of selected colour before ordering material.
 - .2 Accessories: Submit one (1) sample of clips, caps, battens, fasteners, closures, and other exposed panel accessories used in the final panel assembly.

- .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Certificates: Submit qualification statement or certificate stating that fabricator and installer are approved by manufacturer and have the necessary tools, equipment and expertise to undertake work specified in this Section; include lists of completed projects with project names and addresses, names and addresses of Departmental Representatives and owners indicating range of experience.
 - .2 Source Quality Control Submittals: Submit product test reports indicating compliance of manufactured wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
 - .3 Site Quality Control Submittals: Submit written inspection report indicating compliance with manufacturers requirements for installation and system requirements.

1.4 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning procedures, include names of recommended cleaning agents and precautions against materials and methods detrimental to finishes and performance in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and assemblies meeting requirements of CAN/ULC S102 for flame spread and CAN/ULC S134 for assemblies as required by the Authority Having Jurisdiction.
- .2 Qualifications:
 - .1 Manufacturer: Obtain materials from a single manufacturer having a minimum of five (5) years experience and technical support personnel that can provide technical review to panel fabricator to address specific installation requirements.
 - .2 Fabricator: Use fabricator having shop and equipment required to factory fabricate panels to shapes and configurations indicated, having experience with projects of similar complexity and extent, and certified by manufacturer.
 - .3 Installer: Use an experienced installer who has completed solid phenolic panel installations similar in material, design, and extent to that indicated for this project, and with a record of successful in-service performance.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Schedule delivery of products specified in this section to avoid delaying the Work; deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - .2 Storage and Handling Requirements: Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
-

1.7 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

- .1 Manufacturer Warranty: Submit manufacturer's standard 2 year warranty covering loss of colour, and physical and mechanical properties arising from installation, fabrication or manufacture of solid phenolic wall panels; manufacturer's warranty is in addition to; and not a limitation of, other rights contained within the Contract Documents.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Assembly Combustibility Performance: Use only materials and assembly components that have been tested for fire spread and heat flow for non-load bearing exterior wall assemblies in accordance with CAN/ULC S134.
- .2 Deflection:
 - .1 Maximum deflection of perimeter not to exceed L/180 and across panel to exceed L/60 under system own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:30 years.
 - .2 Maximum deflection criteria apply to horizontal plane of system, width and length, as well as vertical deflection. Ensure that adequate stiffeners and fasteners are included to prevent deflection.
- .3 Thermal Movement:
 - .1 Provide for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasonal temperature range from -40°C to +50°C, and preceding noted wind loads.
 - .2 Include expansion joints to accommodate movement in wall system and between wall system and building structure, where these movements are caused by deflection of building structure. Accommodate these movements, without permanent distortion, damage to in fills, or racking of joints.
- .4 Drainage: Provide for positive drainage to the exterior of all water entering or condensation occurring within the system in accordance with NRC Rain Screen Principles.

2.2 EXTERIOR PANELS

- .1 Solid Phenolic Wall Panels: Flat panel comprised of thermosetting resins homogeneously reinforced with cellulose fibres, manufactured under high pressure and temperature and as follows:
 - .1 Mounting Configuration: Prepare panels for non-exposed fastener installation.
 - .2 Panel Thickness: 8 mm
 - .3 Panel Size: Largest sheet stock practical for fabrication of panels to optimize sheet size to dimensions indicated on Drawings and to minimize off-cuts and waste.

- .4 Panel Core: Fire Resistant Black Core meeting requirements of CAN/ULC S102.
- .5 Colour: Selected by Departmental Representative from manufacturer's extended range.
- .6 Finish: Selected by Departmental Representative from manufacturer's extended range
- .2 Joints: Anodized, extruded aluminum H-Profile using manufacturer's standard trims.
- .3 Corner Trims: Manufacturer's standard anodized, extruded aluminum 8 mm radius corner profile.
- .4 Aluminum Sub-Framing Materials: Aluminum extrusions, mill finish meeting requirements for ASTM B221 alloy 6063-T6 in shapes and sizes selected by fabricator as required to suit design loading and wall configuration.
- .5 Aluminum Trim and Accessory Materials: Aluminum sheet or plate, anodized finish meeting requirements for ASTM B209M alloy 6063-T6 in configurations and sizes selected by fabricator as required to suit details.
- .6 Panel Fasteners: Non-corrosive fasteners as recommend by panel manufacturer, and as follows:
 - .1 Attach panel sub-framing system to primary structural supports using manufacturer's recommended concealed fasteners.
 - .2 Attach trims and joint profiles using manufacturer's recommended concealed fasteners for typical joinery.
 - .3 Attach panels to sub-framing using manufacturer's standard non-exposed fasteners.
 - .4 Obtain Departmental Representative's acceptance where exposed fasteners are required in isolated conditions; Departmental Representative will permit a limited number of exposed fasteners obscured within panel joinery using stainless steel fastenings, or in the face of panels using colour matched fastenings.
- .7 Flashings: Prefinished flashings, colour to match panel colours as specified in Section 07 62 00.
- .8 Insulation: Insulation as specified in Section 07 21 13.
- .9 Insulation Fasteners: Corrosion resistant, galvanized bugle head screws with 38 mm diameter washer, 25 mm minimum penetration into framing.
- .10 Air/Vapour Membrane: Bituminous sheet membrane as specified in Section 07 25 13.
- .11 Accessories: Manufacturer's recommended materials required for complete installation.

2.3 FABRICATION

- .1 Fabricate wall panels and components to obtain profiles and details indicated on drawings and as indicated in shop drawings.
- .2 Fabricate components at factory to the greatest extent possible using best shop practices as required by panel manufacturer.

Part 3 Execution

3.1 PREPARATION AND EXAMINATION

- .1 Obtain dimensions from job site before fabricating panels.
- .2 Verify that building surfaces are smooth, clean and dry, and free from defects detrimental to the installation of the system.
- .3 Notify Contractor of conditions not acceptable for installation of system, start of work will indicate acceptance of substrate conditions.
- .4 Inspect all panels and components prior to installation and verify that there is no shipping damage; do not install damaged panels, repair or replace as required for smooth and consistent finished appearance.

3.2 INSTALLATION

- .1 Install air/vapour retarder membrane in accordance with Section 07 25 13.
- .2 Install board insulation in accordance with Section 07 21 13.
- .3 Install sub-framing in accordance with manufacturer's instructions; provide additional framing as may be required to conform to specified performance requirements.
- .4 Install sub-framing attached to structural support or wall framing, using manufacturer's recommended non-exposed fasteners; apply bituminous paint or tape between the dissimilar metals or concrete and aluminum sub-framing materials to isolate against corrosion.
- .5 Install insulation between sub-framing members to maintain continuous thermal barrier using disk type fasteners spaced at nominal 300 mm vertical O/C spaced evenly from edges of insulation, and at nominal 400 mm horizontal O/C, aligning with wall framing.
- .6 Install fasteners into wall framing; do not remove fastener where fastener does not penetrate framing; removal of fastener will damage integrity of air/vapour membrane, realign fastener location and install new fastener in close proximity to original fastener so that it penetrates wall framing.
- .7 Install flashings in accordance with Section 07 62 00 to divert all moisture and condensation to exterior; trim and flash around doors, louvers, windows and other openings.
- .8 Install panels are aligned vertically and horizontally, and flush between adjacent panels to within tolerances indicated; with weep holes and drainage channels free of dirt and sealants that could impede the function of the rain screen assembly.
- .9 Tolerances:
 - .1 Panel Dimensions: Allow for site adjustment and thermal movement.
 - .2 Panel Fabrication: Fabricate panels under controlled shop conditions to the greatest extent possible; site fabrication will only be permitted where minor adjustments are required to account for substrate variations that could not be identified during the preparation of shop drawings.
 - .3 Panel Surfaces: Free of scratches or marks caused during fabrication and installation.
 - .4 Panel Bow: Maximum 0.8% of any 3050 mm panel overall dimension in width or length.

- .5 Panel Flatness: Provide sufficient fastenings in accordance with manufacturers recommendations for specified panel thickness to maintain non-cumulative flatness.
- .6 Panel Joints: 10 mm \pm 0.5 mm joint width between any 2 adjacent panels, vertical or horizontal; 0 mm lippage where 2 adjacent panels share the same sub-framing member; 1 mm lippage where 2 adjacent panels do not share the same sub-framing member.

3.3 SITE QUALITY CONTROL

- .1 Perform final inspection of completed work shall carried out by the manufacturer's representative; prepare a written report and submit to Departmental Representative certifying that installation meets manufacturers requirements and detailing for systems described in this Section.

3.4 CLOSEOUT ACTIVITIES

- .1 Repair or Replacement:
 - .1 Remove and replace panels that are damaged and cannot be repaired; coordinate with Contractor for responsibility of repairs not caused by work of this Section.
 - .2 Touch-up damaged finishes with manufacturer's recommended touch-up paint; touch-up painting will only be permitted where damaged finishes are visible in final installation.
- .2 Cleaning:
 - .1 Remove strippable film coating or masking as soon as possible after surrounding material is installed.
 - .2 Remove excess materials, debris, and equipment at completion.
 - .3 Clean all panels clean and free of all grime and dirt.

3.5 PROTECTION

- .1 Protect installed materials and finish surfaces from damage by other subcontractors for the duration of construction.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for an aluminum composite panel assembly and forming an integrated rain screen assembly vented horizontally and vertically including; but not limited to, the following:
 - .1 Exterior Panel Cladding: Anchorages, shims, furring, fasteners, girts, flashings and adapters, insulation and air/vapour barrier, and closures.
 - .2 Accessory Cladding: Parapets, column covers, soffits, sills, borders and fillers integral to the panel system and required for a complete assembly.

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturer's Association (AAMA):
 - .1 AAMA 508-05, Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
 - .2 AAMA 620-02, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates
- .2 American National Standards Institute (ANSI):
 - .1 ANSI H35.1-2009, Standard Alloy and Temper Designation Systems for Aluminum
- .3 American Society for Testing of Materials (ASTM):
 - .1 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .3 ASTM C393/C393M-06 Standard Test Method for Flexural Properties of Sandwich Constructions by Beam Flexure
- .4 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.108-M89, Bituminous Solvent Type Paint
 - .2 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN4 S114-05, Test for Determination of Non-Combustibility in Building Materials
 - .3 CAN/ULC S134-92 (R1998), Standard Method of Fire Test of Exterior Wall Assemblies

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section with work of other sections that may have items supported by or built into aluminum composite panel assemblies including; but not limited to, supports and connectors to structure, doors and windows, building signage, mechanical and electrical penetrations, erection tolerances and as follows:
 - .1 Pricing: Coordinate with other Sections of the Work during bid period and provide unit prices for materials based on specified thickness and colour of flashing materials required under their respective scopes of work; installing trades will be responsible for carrying cost for flashing materials in their scope of work in their Bid Price.
 - .2 Flashings for Other Work of the Contract: Coordinate work of this section with requirements of Section 07 62 00 for supply of prefinished sheet metal flashing materials to other Sections of the Work with installation by other Sections of the Work as follows:
 - .1 Supply prefinished sheet metal flashings required for the project in sheet metal thickness and colour specified in this Section.
 - .2 Provide prefinished sheet metal flashings tension levelled and guillotine sheared to length ready for brake forming, fabrication and installation.
- .2 Pre-Construction Meetings: Include required participants and an outline agenda for meeting in accordance with Section 01 31 19 – Project Meetings and as follows:
 - .1 Meeting Time: Arrange meeting before starting work k this Section to discuss expectations for fit and finish of aluminum composite panel assemblies, quality of workmanship for installation of air and vapour retarders and transitions, continuity of insulation and relationship of wall system to adjacent components.
 - .2 Participants: Arrange for attendance by Contractor for this Section; Subcontractors of affected components of the Work, manufacturer's representative and Departmental Representative.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit shop drawings indicating attachment methods, joinery, sealing methods and accommodation of thermal movement, drawing at a minimum half full size.
 - .2 Samples for Verification: Submit the following samples:
 - .1 Panels: Submit two (2)-75 mm x 125 mm chip for custom colour approval before ordering material.
 - .2 Accessories: Submit one (1) sample of clips, caps, battens, fasteners, closures, and other exposed panel accessories used in the final panel assembly.
-

- .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Certificates: Submit qualification statement or certificate stating that fabricator and installer are approved by manufacturer and have the necessary tools, equipment and expertise to undertake work specified in this Section; include lists of completed projects with project names and addresses, indicating range of experience.
 - .2 Source Quality Control Submittals: Submit product test reports indicating compliance of manufactured wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
 - .3 Site Quality Control Submittals: Submit written inspection report indicating compliance with manufacturers requirements for installation and system requirements.
 - .4 Submit authorized documentation stating conformation to CAN/ULC S102, S114, and S134.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide panels that are listed and labelled in accordance with CAN/ULC S102, S114 and S134 for fire endurance and flame spread testing.
- .2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturer: Use a manufacturer that has completed wall panel assemblies having similar extent and complexity as required for the Work of this Contract.
 - .2 Installers: Use experienced installers having experience with panel projects similar in material, design and extent as required for Work of this Contract with a record of successful in-service performance.
 - .3 Professional Engineer: Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including; but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals
 - .2 Site review and certification of installed components
 - .4 Manufacturer's Engineering Recommendations: Perform composite wall panel work in accordance with written recommendations from panel manufacturer.
 - .5 Verify panel thickness based on maximum deflections provided in this Section and to suit building location and configuration.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver panels and other components so they will not be damaged or deformed; package panels for protection against damage during transportation or handling.
 - .2 Storage and Handling Requirements: Handling panels with care during unloading, storing, and erection to prevent bending, warping, twisting, and surface damage:
 - .1 Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering
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- .2 Store panels in dry location
- .3 Do not store panels in contact with other materials that might cause staining, denting, or other surface damage

1.7 SITE CONDITIONS

- .1 Site Measurements: Verify locations of structural members and opening dimensions by site measurements before fabrication and indicate measurements on shop drawings for aluminum composite panel assemblies that are indicated to fit other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating wall panel assemblies without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 System Description: Plans, elevations, details, characteristics, and other requirements indicated are based upon materials and details provided by one manufacturer that forms part of this Section and as follows:
 - .1 Responsibility: Professional engineer is responsible for designing composite wall panel assembly, composite panel thickness and connections based on design loads, and verifying that installation meets requirements of the Authority Having Jurisdiction.
 - .2 Provide a rear ventilated rain screen system in accordance with good design practices as established by Canada Mortgage and Housing Corporation for curtain wall assemblies.
 - .3 Provide a system that has no visible fasteners, telegraphing or fastening on the exposed panel faces or other components that detract from a neat and flat finished appearance.
 - .4 Provide a system that does not place restraints on panel that could result in compressive skin stresses, and that will maintain a flat appearance regardless of temperature change.
 - .2 Design fabricated wall panel assemblies to meet or exceed the following minimum requirements:
 - .1 Wind Load: Determine wind loads using post disaster importance factors listed in the Building Code for deflection and strength, modified by the appropriate exposure, gust and pressure (internal and external) factors in accordance with Building Code structural commentaries
 - .2 Deflection Limitation: Maximum deflection of perimeter not to exceed $L/175$ or 19 mm; whichever is less, under system weight plus wind load (positive and negative) loads acting normal to plane of wall under 1 in 50 year sustained wind loading, and as follows:
 - .1 Maximum deflection criteria apply to horizontal plane of system, width and length, as well as vertical deflection.
-

- .2 Include adequate stiffeners and fasteners are included to prevent excessive deflection.
- .3 Thermal Movement: Design system that allows for thermal movements without buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects resulting from the following maximum change in ambient and surface temperatures:
 - .1 Base design calculation on surface temperatures of materials due to both solar heat gain and night time sky heat loss.
- .4 Building Movement: Include provisions to accommodate movement in composite panel system and between composite panel system and building structure where these movements are caused by deflection of building structure.
- .5 Drainage: Provide for positive drainage to the exterior of all water entering or condensation occurring within the system in accordance with NRC Rain Screen Principles.

2.2

COMPOSITE ALUMINUM BUILDING PANEL MATERIALS

- .1 Aluminum Composite Panel: Two sheets of prefinished AA3000 Series aluminum sandwiching a fire rated composite core, formed in a continuous process with no glues or adhesives between dissimilar materials, and as follows:
 - .1 Total composite thickness: 4 mm
 - .2 Core: Non-combustible in accordance with ASTM D1929, CAN/ULC S102, CAN/ULC S114, and CAN/ULC S134
 - .3 Face Sheets: Nominal 0.50 mm thick
 - .4 Finish: Prefinished using manufacturer's standard 2 coat for MP-1 and manufacturer's standard 3 coat for MP-2, thermo-cured system composed of specially formulated inhibitive primer, fluoropolymer colour coat, and clear alkyl ether resin; coil coated with Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in accordance with AAMA 2605 coating thicknesses.
 - .1 Colour: to match Alpolic #439z456M Fluoropon 9721 Metallic and selected by Departmental Representative from manufacturer's standard range

2.3

SYSTEM BACK-UP MATERIALS

- .1 Panel Support System: Thermally Isolated 'Z' Girt System complete with continuous horizontal track and as follows:
 - .1 Z-Girts designed to accommodate insulation depth and allow full thermal expansion and contraction of sheet; cold-rolled, commercial grade structural quality sheet steel (SS), minimum 1.519mm base metal thickness; zinc-coated to ASTM A653/A653M, coating designation Z275.
 - .2 Proprietary system designed and tested to reduce thermal bridging through the exterior wall assembly from the structural metal stud framing to the Z-Girts retaining at least 75% of the calculated wall insulation value to be retained for the 'true insulating value'.
 - .2 Isolation Tape: Manufacturers standard material for separating dissimilar metals from direct contact.
-

- .3 Air/Vapour Retarder: Membrane as specified in Section 07 25 13.
- .4 Insulation: As specified in Section 07 21 13.
- .5 Insulation Fastenings: Corrosion resistant, galvanized bugle head screws with 38 mm diameter washer, 25 mm minimum penetration into framing.

2.4 ACCESSORIES

- .1 Extrusions: Formed aluminum members, sheet, and plate in accordance with ASTM B209 and manufacturers written recommendations and as follows:
 - .1 Perimeter Extrusions: Alloy: AA-6063-T5, mill finish where non-exposed; to match panels when exposed.
 - .2 Stiffeners: Alloy: AA-6063-T5, mill finish
- .2 Panel Stiffeners: Structurally fastened or restrained at ends, secured to rear face of composite panel with silicone or double sided high bond isolating tape to prevent weather staining and frost lines to the face of the panel as recommend by panel manufacturer; size stiffeners to maintain panel flatness to specified tolerances; material as recommended by panel manufacturer.
- .3 Sealants and Gaskets: Panel system components as recommended by panel manufacturer to meet performance requirements.
- .4 System Sealants: Sealants within the panel system, type as recommended by manufacturer, colour to match panel finish.
- .5 Flashings: Fabricate flashing from 0.75 mm minimum thickness aluminum sheet, coloured to match panel where exposed to view; provide lap strip under flashing at butted conditions, with lapped surfaces sealed in a full bed of non-hardening sealant.
- .6 Fasteners: Non-corrosive fasteners as recommend by panel manufacturer, and as follows:
 - .1 Attachment panel system to primary panel structural supports using manufacturer's recommended concealed fasteners.
 - .2 Use concealed fasteners for typical joinery.
 - .3 Obtain Departmental Representative's acceptance where exposed fasteners are required in isolated conditions; Departmental Representative will permit a limited number of exposed fasteners obscured within panel joinery using stainless steel fastenings, or in the face of panels using colour matched fastenings.

2.5 FABRICATION

- .1 Fabricate composite wall panels and components to obtain profiles and details indicated on drawings and as indicated in shop drawings.
- .2 Fabricate components at factory to the greatest extent possible using best shop practices as required by panel manufacturer.
- .3 Fabricate components to match quality and installation of reviewed mock-up specified above.

Part 3 Execution

3.1 PREPARATION AND EXAMINATION

- .1 Obtain dimensions from job site before fabricating panels.
- .2 Verify that building surfaces are smooth, clean and dry, and free from defects detrimental to the installation of the system.
- .3 Notify Contractor of conditions not acceptable for installation of system, start of work will indicate acceptance of substrate conditions.
- .4 Inspect all panels and components prior to installation and verify that there is no shipping damage; do not install damaged panels, repair or replace as required for smooth and consistent finished appearance.

3.2 INSTALLATION

- .1 Install air/vapour retarder membrane in accordance with Section 07 25 13.
- .2 Install board insulation in accordance with Section 07 21 13.
- .3 Install girts in accordance with manufacturer's instructions. Provide additional metal framing as may be required to conform to Performance Requirements.
- .4 Install girts attached to structural support or wall framing, using recommended fasteners.
- .5 Install additional stiffeners from grade to 1200mm, or closest panel joint to 1200mm.
- .6 Install insulation between girts forming tight to following applied girt to maintain continuous thermal barrier. Install insulation with disk type fasteners spaced at 305 mm vertical o/c spaced evenly from edges of insulation, and at 406 mm horizontal o/c.
- .7 Install fasteners into wall framing; do not remove fastener where fastener does not penetrate framing; removal of fastener will damage integrity of air/vapour membrane, realign fastener location and install new fastener in close proximity to original fastener so that it penetrates wall framing.
- .8 Install flashings to divert all moisture and condensation to exterior. Trim and flash around doors, louvers, and windows.
- .9 Install exterior metal cladding to structural support by hidden mechanical fasteners.
- .10 Apply bituminous paint or caulking tape to insulate between the dissimilar materials and aluminum materials. Factory applied protective paint or G-90 galvanized steel is considered adequate insulation.
- .11 Install pre-formed corners and end enclosures, sealed to arrest direct weather penetration.
- .12 Install panels are aligned vertically and horizontally, and flush between adjacent panels to within tolerances indicated; with weep holes and drainage channels free of dirt and sealants that could impede the function of the rain screen assembly.
- .13 Assemble and secure wall system so stresses on sealants are within manufacturers' recommended limits.
- .14 Tolerances:
 - .1 Panel Dimensions: Allow for site adjustment and thermal movement.

- .2 Panel Fabrication: Fabricate panels under controlled shop conditions to the greatest extent possible; site fabrication will only be permitted where minor adjustments are required to account for substrate variations that could not be identified during the preparation of shop drawings.
- .3 Panel Lines, Breaks and Curves: Form changes in direction sharp, smooth, and free of warps or buckles.
- .4 Panel Surfaces: Free of scratches or marks caused during fabrication and installation.
- .5 Panel Bow: Maximum 0.8% of any 1830 mm panel overall dimension in width or length.
- .6 Panel Flatness: Maximum 3 mm in 1525 mm deviation from panel flatness non-cumulative; no oil canning.
- .7 Panel Joints: Maximum 1 mm lippage between any 2 adjacent panels not attached with same fastener; 0 mm lippage where 2 adjacent panels share the same fastener.

3.3 SITE QUALITY CONTROL

- .1 Perform final inspection of completed work shall carried out by the manufacturer's representative; prepare a written report and submit to Departmental Representative certifying that installation meets manufacturers requirements and detailing for systems described in this Section.
- .2 Perform final inspection with Departmental Representative, Contractor and Subcontractor, present; provide a minimum of 72 hours notice so that all parties can confirm their attendance.

3.4 TOUCH-UP AND CLEANING

- .1 Remove and replace panels that are damaged and cannot be repaired; coordinate with Contractor for responsibility of repairs not caused by work of this Section.
- .2 Remove strippable film coating or masking as soon as possible after surrounding material is installed.
- .3 Remove excess materials, debris, and equipment at completion.
- .4 Clean all panels clean and free of all grime and dirt.
- .5 Touch-up damaged finishes with manufacturer's recommended touch-up paint.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .2 CGSB 37-GP-56M-80(1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
 - .3 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .2 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA A123.21-10, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems
 - .2 CAN/CSA-A123.3-05(R2010), Asphalt Saturated Organic Roofing Felt.
 - .3 CAN/CSA-A123.4-04(R2008), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .2 CAN/ULC-S706-09, Standard for Wood Fibre Thermal Insulation for Buildings.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative and Departmental Representative in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
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- .2 Product Data:
 - .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 43, and indicate VOC content for:
 - .1 Primers.
 - .2 Asphalt.
 - .3 Sealers.
 - .4 Filter fabric.
- .3 Provide shop drawings:
 - .1 Indicate flashing, tapered insulation details.
 - .2 Provide layout for tapered insulation.
- .4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and membrane with specification requirements.
- .6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .7 Manufacturer's field report: in accordance with Section 01 45 00.
- .8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience and as approved by manufacturer.

1.5 FIRE PROTECTION

- .1 Fire Extinguishers:
 - .1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,
 - .2 ULC labelled for A, B and C class protection.
 - .3 Sizes as indicated by the Departmental Representative on roof per torch applicator, within 6 m of torch applicator.
- .2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00.
- .2 Storage and Handling Requirements:

- .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
- .2 Provide and maintain dry, off-ground weatherproof storage.
- .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
- .4 Remove only in quantities required for same day use.
- .5 Place plywood runways over completed Work to enable movement of material and other traffic.
- .6 Store sealants at +5 degrees C minimum.
- .7 Store insulation protected from daylight and weather and deleterious materials.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates and packaging materials in accordance with Section 01 74 20.
 - .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .2 Fold up metal banding, flatten and place in designated area for recycling.

1.7 FIELD CONDITIONS

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

1.8 WARRANTY

- .1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, 12 months warranty period is extended to 24 months.

Part 2 PRODUCTS

2.1 PERFORMANCE CRITERIA

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.
- .2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 DECK PRIMER

- .1 Asphalt primer: to CGSB 37-GP-9Ma.

2.3 VAPOUR RETARDER

- .1 Modified bituminous, self-adhering roof membrane, designed specifically for installation to dry steel decks; width 1140 mm and having a non-slip surface and UV resistant opaque surface.
- .2 Vapour retarder continuity strip: SBS membrane with non-woven polyester reinforcement, glass grid and elastomeric bitumen. Sanded upper surface; underside self-adhesive, compatible with wall and roof air/vapour retarder membranes as recommended by manufacturer.

2.4 MEMBRANE

- .1 Base sheet: to CGSB 37-GP-56M.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class C - plain surfaced.
 - .4 Grade 2 - heavy duty service.
 - .5 Top and bottom surfaces:
 - .1 sanded/polyethylene.
 - .6 Base sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 17.0/18.0 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): 60/70%.
 - .4 Tear resistance: 85 N.
 - .5 Cold bending at -30°C: no cracking.
 - .6 Softening point: \geq 110°C.
 - .7 Static puncture resistance: >400.
 - .8 Dimensional Stability: -0.3/0.3 %.
 - .7 ULC certification: Class A.
- .2 Cap sheet membrane: to CGSB 37-GP-56M.
 - .1 Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, glass reinforcement, having nominal weight of 250g/m².
 - .2 Type 1, fully adhered.
 - .3 Class A-granule surfaced.
 - .1 Colour for granular surface: Light grey colour as approved by Departmental Representative.
 - .4 Grade 2- heavy duty service.
 - .5 Bottom surface polyethylene.
 - .6 Cap sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 13.0/10.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.
 - .3 Ultimate elongation (longitudinal/transversal): 63/73%.

- .4 Tear resistance: 80 N.
- .5 Cold bending at -30°C: No cracking.
- .6 Softening point: $\leq 110^{\circ}\text{C}$.
- .7 Static puncture resistance: >400 .
- .8 Dimensional Stability: -0.2 / 0.2 %.
- .7 ULC certification: Class A

2.5 ADHESIVE

- .1 Membrane Roofing Materials Adhesive: Cold adhesive-mastic composed of a bituminous binder, added to bonding agents and solvents compatible with specified roofing products.
- .2 Insulation Adhesive: Manufacturers standard adhesives specifically formulated for installation of plastic insulation to roofing materials.
- .3 Gypsum Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of gypsum board to metal deck.

2.6 OVERLAY BOARD

- .1 Overlay Board: 12.7 mm asphalt impregnated fiberboard.
 - .1 Install over insulation to provide torch safe surface.

2.7 BITUMEN

- .1 Asphalt: to CAN/CSA-A123.4 and as follows:
 - .1 Type 2 oxidized asphalt for slopes $\leq 2\%$
 - .2 Type 3 oxidized asphalt for slopes between 2% and 25%.

2.8 POLYISOCYANURATE INSULATION

- .1 Primary Flat and Sloped Insulation: Polyisocyanurate foam rigid board roof insulation, of largest panels practical, having square edges, minimum LTTR RSI 1.04/25 mm, total thickness as indicated on Drawings, sloped to a minimum 2% perpendicular from edge of roof to a minimum thickness of 25 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension.

2.9 SEALERS

- .1 Plastic cement: asphalt.
- .2 Sealing compound: rubber asphalt type.
- .3 Sealants: Caulking - see Section 07 92 00.

2.10 CARPENTRY

- .1 Refer to Section 06 10 00.01
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Part 3 EXECUTION

3.1 QUALITY OF WORK

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies will be fitted with durable rigid material sheet metal providing connection point for continuity of air barrier.
- .4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Evaluation and Assessment:
 - .1 Prior to beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
 - .2 Curbs have been built.
 - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
 - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
- .3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 PRIMING DECK

- .1 Apply deck primer to metal roofing substrate at the rate recommended by manufacturer.

3.5 VAPOUR RETARDER (STEEL DECK)

- .1 Adhere vapour retarder using solvent based adhesive as per manufacturer's instructions.

3.6 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Insulation: fully adhered, adhesive application:

- .1 Adhere insulation to steel deck using solvent-based adhesive.
- .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
- .3 Cut end pieces to suit.
- .4 Apply adhesive in continuous ribbons at 300 mm on centre.
- .5 Separate the membrane and insulation with a drainage layer or slipsheet.

- .2 Insulation: fully adhered, bitumen application:

- .1 Embed insulation in 1 to 1.5 kg/m² mopping of bitumen.
- .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
- .3 Cut end pieces to suit.

- .3 Tapered insulation application:

- .1 Mop insulation to vapour retarder and top layer of insulation to bottom layer with hot asphalt at rate of 1 kg/m².
- .2 Install tapered insulation as second insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

- .4 Overlay Board: adhesive application:

- .1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m².
- .2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.
- .3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

- .5 Base sheet application:

- .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
- .2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
- .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
- .4 Application to be free of blisters, wrinkles and fishmouths.

- .6 Cap sheet application:

- .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
-

- .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
- .4 Application to be free of blisters, fishmouths and wrinkles.
- .5 Do membrane application in accordance with manufacturer's recommendations.
- .7 Flashings:
 - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Nail sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations and Section 07 62 00.
- .8 Roof penetrations:
 - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.7 FIELD QUALITY CONTROL

- .1 Inspections:
 - .1 Departmental Representative will pay for tests as specified in Section 01 45 00.
 - .2 Inspection and testing of roofing application will be carried out by testing laboratory designated by Departmental Representative.

3.8 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Place materials defined as hazardous or toxic in designated containers.
 - .2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
 - .3 Ensure emptied containers are sealed and stored safely.

- .4 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .5 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.
- .6 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.
- .7 Dispose of unused asphalt material at official hazardous material collections site approved by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C1002-07, Standard Specification for Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .2 ASTM C1177-08/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .3 ASTM D41-11/D41M-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .4 ASTM D312-00(2006), Asphalt Used in Roofing.
 - .5 ASTM D448-08, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 - .6 ASTM D2178-04, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 - .7 ASTM D6162-00a(2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
 - .8 ASTM D6163-00(2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .9 ASTM D6164-11/D6164M-11, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .2 Canadian General Standards Board (CGSB).
 - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Used, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .2 CGSB 37-GP-56M-80b(A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
 - .3 CAN/CGSB 51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .3 Canadian Roofing Contractors Association (CRCA).
 - .1 CRCA Roofing Specifications Manual
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA A123.16-M88(R2001), Asphalt-Coated Glass-Base Sheet.
 - .2 CAN/CSA A123.4-98, Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999.

- .6 Factory Mutual (FM Global).
 - .1 FM Approval Standard #4470, Class 1 Roof Covers.
 - .2 FM Roof Assembly Classifications.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .8 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992.
- .9 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 ULC - List of Equipment and Materials for:
 - .1 Building Materials.
 - .2 Fire Resistance.
 - .3 Firestop Systems and Components.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two copies of most recent technical roofing components data sheets describing materials' physical properties of the following materials: membrane, bitumen, base flashing, and insulation.
- .3 Shop Drawings: Submit membrane manufacturer's standard and modified details that will be utilized for this project; indicate changes that must be made to make manufacturer's details project specific for review by Departmental Representative.
- .4 Product Data: provide membrane and bitumen materials, base flashing materials, insulation.
- .5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .6 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .7 Section 01 45 00: manufacturer's field reports.
- .8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.
- .9 Informational Submittals: Provide the following submittals during the course of the work of this Section:
 - .1 Root Barrier Certificate: Submit test report prepared by membrane system manufacturer indicating that root barrier materials successfully pass SPRI VR-1 for vegetation proposed for use on this Project.
 - .2 Roofing Membrane Certificate: Submit certification from an independent testing laboratory experienced in testing rubberized asphalt material stating that material supplied for the Project meets or exceeds referenced standards.

- .3 Source Quality Control Submittal: Submit certification indicating full time quality control of production facilities responsible for manufacture of rubberized asphalt and batch records for tested material indicating conformance to manufacturer's published physical properties.
- .4 Site Quality Control: Submit certification indicating that components used in the vegetated roofing system are supplied and warranted by a single source manufacturer; indicate results and corrective actions for initial and final leak control tests.
- .5 Manufactured Soil Mix Certification: Submit certification that soil mix and planting material weights are in accordance with specified values and that soil mix is capable of supporting vigorous growth of planting materials including the following:
 - .1 Soil mix analysis prepared by a qualified soil testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; soil and planting moduleium absorption ratio; deleterious material; pH; and mineral and plant nutrient content of topsoil
 - .2 Report suitability of manufactured soil for plant growth
 - .3 State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments added to produce a satisfactory growing media.

1.3 QUALITY ASSURANCE

- .1 Perform Work in accordance with CRCA Roofing Specifications' Manual and manufacturer's instructions.

1.4 QUALIFICATIONS

- .1 Manufacturer: company specializing in manufacturing the products specified in this section with 5 years documented experience.
- .2 Applicator: company specializing in performing the work of this section with 5 years documented experience and approved by membrane manufacturer.
- .3 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Roofing Installer: Maintain full time experienced journeyman roofer and at least one apprentice per crew on the work at all times and as follows:
 - .1 Roofing Subcontractor and subcontractors must have Approved Contractor status by the roofing membrane manufacturer.
 - .2 Use only skilled and certified trade persons, officially employed by a roofing contractor operating adequate and necessary equipment, and who are thoroughly trained and experienced and completely familiar with manufacturer's recommended methods of installation.
 - .3 Crewmembers using torches must be trained under a recognized training program and certified from the manufacturer of materials being installed.

- .2 Soil Mix and Planting Supplier: Obtain growers that are a member in good standing of a provincial Landscape Nursery Trades Association and that provide only nursery grown plantings specifically selected for drought resistance and hardiness in roof top installations; and that has a proven soil mix program meeting requirements of specified vegetated roofing system.
- .3 Soil and Planting Installer: Use installers that are approved by soil mix and planting supplier and that specializes in the installation of vegetated roofing plantings having experience with projects of similar complexity and size.

1.5 REGULATORY REQUIREMENTS

- .1 FM: Roof Assembly Classification, of class 1-110 Wind Uplift Construction.

1.6 PRE-INSTALLATION MEETINGS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Investigate substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.7 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, protect, and handle products to site in accordance with Section 01 61 00.
- .2 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- .3 Store products in weather protected environment, clear of ground and moisture.
- .4 Store rolls of felt and membrane in upright position. Store membrane rolls with selvage edge up.
- .5 Remove only in quantities required for same day use.
- .6 Place plywood runways over work to enable movement of material and other traffic.
- .7 Store sealants at +5°C minimum.
- .8 Handle roofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

1.9 PROTECTION

- .1 Fire Extinguishers: maintain one cartridge operated type or stored pressure rechargeable type with shut-off nozzle, ULC labelled for A, B and C class protection. Sizes as indicated by the Departmental Representative on roof per torch applicator, within 6 m of torch applicator.
 - .2 Maintain fire watch for 1 hour after each days roofing operations cease.
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1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
- .6 Ensure emptied containers are sealed and stored safely.
- .7 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .8 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.
- .9 Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.
- .10 Dispose of unused asphalt material at official hazardous material collections site approved by Departmental Representative.
- .11 Fold up metal banding, flatten and place in designated area for recycling.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install roofing during inclement weather when temperature remains below -18°C for torch application, or -10°C and to manufacturers' recommendations for torch application.
- .2 Minimum temperature for solvent-based adhesive is -5°C.
- .3 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .4 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.12 WARRANTY

- .1 For Work in this Section 07 55 63 - Vegetated Protected Membrane Roofing, 12 months warranty period prescribed in subsection GC3.13 of General Conditions is extended to 24 months.
 - .2 Vegetated Materials Special Warranty: Provide warranty from soil and planting supplier and installer covering a period of three (3) months after completion of maintenance period required by this Section for patching or replacement of plantings that fails to grow or that die within the same growing season; it is recognized that the following conditions are outside of the supplier's and installer's control and will be considered as specific exclusions to the warranty and are not covered by the Special Warranty:
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- .1 Plantings that are damaged by subsequent construction activities, negligence by the Owner, damage by animals or insects, or extreme weather events
- .2 Planting that are damaged by herbicides, pesticides or fertilizer that are not supplied and properly applied by this Section
- .3 Plantings that fail to grow after one (1) month in subsequent growing season after wintering and proof of growth during the previous fall planting season will be covered by the same warranty conditions as listed above.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 **Manufactured Soil:** Lightweight soil mix consisting of proprietary growing media and fertilizer specifically formulated for extensive vegetated roof installations suitable for sustained healthy growth of planting materials based on geographic location and building orientation; soil mix must be tested and be accompanied by an Agrologist's report indicating that it is suitable for growing specified planting materials.
- .2 **Ballast:** Design roof system to account for wind uplift conditions and provide additional ballasting methods and materials to account for building height, parapet configuration, to prevent erosion of soil materials and to meet performance requirements listed below.

2.2 PERFORMANCE REQUIREMENTS

- .1 **Compatibility:** Verify that roofing materials are provided by the same manufacturer or are compatible with one another when provided by different manufacturers and as follows:
 - .1 Roofing materials must be compatible with air and vapour retarder specified under Section 07 25 13.
 - .2 Provide a written declaration to the Departmental Representative that roofing materials and components are compatible with wall air and vapour retarder membranes.
- .2 Provide a membrane roofing system that resists corner, perimeter and field-of-roof uplift pressure criteria established by referenced SPRI Wind Load Design Guide, using Building Code 1/50 year wind pressures for location of installation.

2.3 DECK PRIMER

- .1 Asphalt primer: to CGSB 37-GP-9Ma.

2.4 VAPOUR RETARDER

- .1 Modified bituminous, self-adhering roof membrane, designed specifically for installation to dry steel decks; width 1140 mm and having a non-slip surface and UV resistant opaque surface.
- .2 Vapour retarder continuity strip: SBS membrane with non-woven polyester reinforcement, glass grid and elastomeric bitumen. Sanded upper surface; underside self-adhesive, compatible with wall and roof air/vapour retarder membranes as recommended by manufacturer.

2.5 MEMBRANE

- .1 Base sheet: to CGSB 37-GP-56M.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class C - plain surfaced.
 - .4 Grade 2 - heavy duty service.
 - .5 Top and bottom surfaces:
 - .1 sanded/polyethylene.
 - .6 Base sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 17.0/18.0 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): 60/70%.
 - .4 Tear resistance: 85 N.
 - .5 Cold bending at -30°C: no cracking.
 - .6 Softening point: δ 110°C.
 - .7 Static puncture resistance: >400.
 - .8 Dimensional Stability: -0.3/0.3 %.
 - .7 ULC certification: Class A.
- .2 Cap sheet membrane: to CGSB 37-GP-56M.
 - .1 Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, glass reinforcement, having nominal weight of 250g/m².
 - .2 Type 1, fully adhered.
 - .3 Class A-granule surfaced.
 - .1 Colour for granular surface: Light grey colour as approved by Departmental Representative.
 - .4 Grade 2- heavy duty service.
 - .5 Bottom surface polyethylene.
 - .6 Cap sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 13.0/10.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.
 - .3 Ultimate elongation (longitudinal/transversal): 63/73%.
 - .4 Tear resistance: 80 N.
 - .5 Cold bending at -30°C: No cracking.
 - .6 Softening point: δ 110°C.
 - .7 Static puncture resistance: >400.
 - .8 Dimensional Stability: -0.2 / 0.2 %.
 - .7 ULC certification: Class A

2.6 ADHESIVE

- .1 Membrane Roofing Materials Adhesive: Cold adhesive-mastic composed of a bituminous binder, added to bonding agents and solvents compatible with specified roofing products.
- .2 Insulation Adhesive: Manufacturers standard adhesives specifically formulated for installation of plastic insulation to roofing materials.
- .3 Gypsum Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of gypsum board to metal deck.

2.7 OVERLAY BOARD

- .1 Overlay Board: 12.7 mm asphalt impregnated fiberboard.
 - .1 Install over insulation to provide torch safe surface.

2.8 BITUMEN

- .1 Asphalt: to CAN/CSA-A123.4 and as follows:
 - .1 Type 2 oxidized asphalt for slopes $\leq 2\%$
 - .2 Type 3 oxidized asphalt for slopes between 2% and 25%.

2.9 POLYISOCYANURATE INSULATION

- .1 Primary Flat and Sloped Insulation: Polyisocyanurate foam rigid board roof insulation, of largest panels practical, having square edges, minimum LTTR RSI 1.04/25 mm, total thickness as indicated on Drawings, sloped to a minimum 2% perpendicular from edge of roof to a minimum thickness of 25 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension.

2.10 SEALERS

- .1 Plastic cement: asphalt.
- .2 Sealing compound: rubber asphalt type.
- .3 Sealants: Caulking - see Section 07 92 00.

2.11 CARPENTRY

- .1 Refer to Section 06 10 00.01

2.12 PREMANUFACTURED VEGETATED ROOFING MATERIALS

- .1 Growing Medium: Proprietary engineered soil mix based on German FLL granulometric specifications, nominal 94% dry weight inorganic content, having a dry weight of between 950 to 1050 kg/m³ after addition of organics and other soil amendments based on local growers soil mix; having a soil placed thickness of approximately 100 mm.
 - .2 Premanufactured Soil Modules: Polypropylene soil containment modules 305 mm x 610 mm x 80 mm high and having 2.5 mm thick walls; containing no VOC content; profiled to allow for high flow water dispersal; and having a vegetated weight of approximately 195 to 245 kg/m² after installation and watering.

- .3 Plant Materials: Regionally grown, drought resistant, shade resistant plants consisting of a mix of sedum and other succulents adapted to local growing conditions and anticipated growing conditions at roof location; grown to maturity with approximately 95% soil coverage.
- .4 Pavers/Ballast: Concrete pavers having integral plastic base; 305 mm x 610 mm x 100 mm high, weighing nominal 24 kg; colour selected by Departmental Representative from manufacturer's standard range.
- .5 Vegetated Roofing Accessories: Aluminum edging strips, shims, soil extenders, and other materials and components required as a part of a complete vegetated roofing installation.

2.13 BALLAST

- .1 Stone Ballast: Well screened and washed stone gravel meeting the requirements of ASTM D1863/D1863M

2.14 ACCESSORIES

- .1 Installation Accessories: Provide auxiliary materials recommended by roofing system manufacturer for intended use and compatible with specified membrane roofing system.
- .1 Planting Restraint Edging: Extruded aluminum edging angle specifically manufactured for containment of vegetated roofing modules; having nominal height 75 mm x 83 mm width, mill finish aluminum with manufacturer's recommended installation accessories, connectors, corner units and fasteners.
- .2 Leak Detection System: Compatible with installed membranes and as specified in Section 07 08 25 including data connections and accessories required for complete installation.
- .3 Securement Bars: Continuous aluminum or stainless steel bars; 3 mm thickness x 25 mm wide; predrilled ready for corrosion proof fasteners at 300 mm o/c.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual.
- .2 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
 - .1 Verify that surfaces and site conditions are ready to receive work.
 - .2 Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.
 - .3 Verify deck surfaces are dry and free of snow or ice; do not use calcium or salt for ice or snow removal.
 - .4 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and cant strips are in place.

- .5 Verify roof drain is set to achieve weep drainage at membrane level and top grating of drain at finish deck level.
- .6 Do not install roofing materials during rain or snowfall.
- .7 Correct deficiencies before starting roofing application Work.
- .3 Vegetated Component Examination: Verify that roofing system is complete and constructed in accordance with roof system manufacturer's requirements and that root barrier is installed correctly.

3.2 PROTECTION

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

3.3 PRIMING DECK

- .1 Apply deck primer to metal roofing substrate at the rate recommended by manufacturer.

3.4 VAPOUR RETARDER (STEEL DECK)

- .1 Adhere vapour retarder using solvent based adhesive as per manufacturer's instructions.

3.5 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Insulation: fully adhered, adhesive application:
 - .1 Adhere insulation to steel deck using solvent-based adhesive.
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end pieces to suit.
 - .4 Apply adhesive in continuous ribbons at 300 mm on centre.
 - .5 Separate the membrane and insulation with a drainage layer or slipsheet.
- .2 Insulation: fully adhered, bitumen application:
 - .1 Embed insulation in 1 to 1.5 kg/m² mopping of bitumen.
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end pieces to suit.
- .3 Tapered insulation application:
 - .1 Mop insulation to vapour retarder and top layer of insulation to bottom layer with hot asphalt at rate of 1 kg/m².

- .2 Install tapered insulation as second insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.
- .4 Overlay Board: adhesive application:
 - .1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m².
 - .2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.
 - .3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.
- .5 Base sheet application:
 - .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
 - .2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .4 Application to be free of blisters, wrinkles and fishmouths.
- .6 Cap sheet application:
 - .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
 - .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
 - .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
 - .4 Application to be free of blisters, fishmouths and wrinkles.
 - .5 Do membrane application in accordance with manufacturer's recommendations.
- .7 Flashings:
 - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Nail sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations and Section 07 62 00.

3.6 INSTALLATION VEGETATED COMPONENT

- .1 Leak Detection System: Coordinate installation of leak detection system with Section 07 08 25 and as follows:

- .1 Initial Leak Detection Test: Coordinate with leakage testing agency, protect interior building components against damage arising from leakage testing and perform testing; include initial leak detection testing and repair costs as a part of the Contract Price.
- .2 Membrane Repairs: Repair membrane leaks and deficiencies before starting installation of remaining vegetated membrane roofing components.
- .2 Accessories: Fit drains with inspection and maintenance boxes and grills, build up to top of soil level install other accessories indicated or as required to meet performance requirements and as follows:
 - .1 Install gravel ballast to field areas of designated roofs in accordance with manufacturers written instructions, at minimum rate of 110 kg/m²; spread gravel onto filter cloth.
 - .2 Install dividers between gravel ballast and paved areas.
 - .3 Install pavers as indicated at roof perimeter and adjacent to building walls, roof penetrations and access hatches.
- .3 Vegetated Roofing Components: Install premanufactured vegetated roofing modules and related roof components in accordance with manufacturer's written instruction as required for warranty coverage and to meet assembly requirements listed on Drawings and in these specifications.
- .4 Final Leak Detection Testing: Electronically retest membrane installation after installation of planting materials, vegetated roofing system, concrete pavers and planters and accessories to verify that membrane is intact, coordinate repairs where damage is caused by planting operations.
- .5 Fertilizing Program: Fertilize during establishment and warranty periods at a rate and frequency recommended by vegetated roofing materials provider until healthy growth is established.
- .6 Maintenance during Planting Establishment Period: Perform following operations from time of installation until healthy growth is established:
 - .1 Water vegetated areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition.
 - .2 Maintain vegetated areas 95% weed free.
 - .3 Consultant will accept installation provided that vegetated areas are properly established and free of bare and dead spots with no surface soil visible from a height of 1500 mm.
 - .4 Areas planted in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.7 FIELD QUALITY CONTROL

- .1 Require site attendance of roofing materials manufacturer's representative during installation of Work.
 - .2 Field quality control is under control of Contractor. Field quality assurance is monitored by Departmental Representative.
 - .3 Inspection and testing of roofing application will be carried out by testing laboratory designated by Departmental Representative.
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- .4 Departmental Representative will pay for tests as specified in Section 01 45 00.
- .5 Maintenance of Vegetated Areas during Warranty Period: Perform following operations from time of acceptance until end of warranty period:
 - .1 Water and apply fertilizer to vegetated areas as necessary to obtain optimum soil moisture conditions and to establish healthy growth; record duration and quantity of water applied; record type and amount of fertilizer per 100 m²; record lab results if soil tests are conducted.
 - .2 Repair or replace planting materials to dead or bare spots before expiration of warranty period.
 - .3 Eliminate weeds by hand to extent acceptable listed above.

3.8 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 The Aluminum Association Inc. (AAI)
 - .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
 - .2 AAI DAF 45-03(R2009), Designation System for Aluminum Finishes.
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A240/A240M-13a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .3 ASTM A606-09a/A606M-09a, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - .4 ASTM A653-11/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM A792-10/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .6 ASTM B32-08, Standard Specification for Solder Metal.
 - .7 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction.
 - .8 ASTM D523-08, Standard Test Method for Specular Gloss.
 - .9 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - .3 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
 - .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
 - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
 - .5 Canadian Standards Association (CSA International)
 - .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
 - .2 AAMA/WDMA/CSA 101/I.S.2/A440-2008, Standard/Specification for Windows, Doors, and Unit Skylights.
 - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples, withdrawn.
 - .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .7 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule #1113-04, Architectural Coatings.
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- .2 SCAQMD Rule #1168-05, Adhesives and Sealants.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.
- .3 Shop Drawings:
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures .
 - .2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SHEET METAL MATERIALS

- .1 Zinc coated steel sheet: Minimum 0.45 mm thickness, commercial quality, Type A. Grade 230 to ASTM A653/A653M, with Z275 designation zinc coating.
- .2 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, Type A, Grade 275 with AZM180 coating, smooth surface, minimum 0.45 mm base metal thickness.
- .3 Formed Aluminum: Tension levelled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 3003-H14, 1.00 mm base metal thickness.
- .4 Zinc: Tension levelled, titanium/zinc alloy sheet in accordance with EN 988, 0.80 mm base metal thickness

2.2 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied polyvinylidene fluoride.
 - .1 Class F1S
 - .2 Colour selected by Departmental Representative from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/- in accordance with ASTM D523.
 - .4 Coating thickness: not less than 22 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000 hours.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB-37.5.
- .3 Mastic Sealant: CAN/CGSB 37.29 polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- .1 Slip Sheet: CSA A123.3, No. 15 perforated asphalt saturated felts.
- .2 Flexible Flashing: Polyethylene faced bituminous membrane materials compatible with membrane air and vapour retarder specified in Section 07 25 13, not less than 0.5 mm thick and be compatible with all other materials being used and mastic compatible and approved for use with the flashing material.
- .3 Sealants: As indicated in Section 07 92 00.
- .4 Epoxy Seam Sealer: Two component, non-corrosive, aluminum seam cementing compound, recommended by aluminum manufacturer for exterior and interior non-moving joints, including riveted joints.
- .5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness 1.2 mm.
- .6 Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

- .8 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
- .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm.
- .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of thicknesses and finish indicated to suit adjacent material.

2.6 REGLETS AND CAP FLASHINGS

- .1 Provide secure interlocking of separate reglet and counter flashing pieces compatible with flashing indicated generally of type, material, and profile indicated, formed as follows:
- .1 Surface Mounted Type: Form with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
- .2 Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
- .3 Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counter flashing or where Drawings show reglet without metal counter flashing.
- .4 Counter Flashing Wind Restraint Clips: Provide clips being installed before counter flashing to prevent wind uplift of the counter flashing lower edge.
- .2 Material:
- .1 Aluminum: 0.60 mm thick.
- .2 Galvanized steel: 0.45 mm base metal thickness.

2.7 SCUPPERS

- .1 Form scuppers from minimum 0.80 mm thick aluminum.
- .2 Coil Coated Galvanized Steel: 0.70 mm thick.
- .3 To match material where located

- .4 Provide necessary fastenings.

2.8 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with AA DAF45.
 - .1 Integral colour anodic finish: designation AA-3003-H14, colour to match Departmental Representative's sample.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets to form weather tight junction.
- .8 Caulk flashing at reglet with sealant.
- .9 Install pans, where shown around items projecting through roof membrane.

3.3 SCUPPERS

- .1 Install scuppers as indicated.

3.4 FIELD QUALITY CONTROL

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

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
 - .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
 - .3 Leave work areas clean, free from grease, finger marks and stains.
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END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for design, supply and installation of mineral fibre mineral fibre fireproofing, having a fire resistance rating as indicated on drawings applied to underside of steel decking, and supporting structural steel framing and joists including; but not limited to, work required to patch, repair and make good after installation of adjacent materials that may cause damage to completed work of this Section.
- .2 Structural steel elements that are protected by masonry, concrete, or a rated gypsum board assembly do not require protection using materials specified in this Section provided that protection provided meets required fire resistance as determined from Chapter 2 of Supplement to Building Code.

1.2 RELATED REQUIREMENTS

- .1 Section 05 05 19 – Common Work Results for Metalwork Finishing: Coordination of surface preparation and priming requirements for structural steel surfaces.
- .2 Section 05 12 23 – Structural Steel: Substrate preparation for structural steel framing requiring fire rating.
- .3 Section 05 21 00 – Steel Joist Framing: Substrate preparation for structural steel joist framing requiring fire rating.
- .4 Section 05 31 00 – Steel Decking: Substrate preparation for steel decking requiring fire rating.
- .5 Section 07 84 00 – Firestopping

1.3 REFERENCE STANDARDS

- .1 American Society for Testing of Materials (ASTM):
 - .1 ASTM E119-12a, Standard Test Methods for Fire Tests of Building Construction and Materials
 - .2 ASTM E605-93 (2011), Tests for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members
 - .3 ASTM E736-00 (2011), Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
 - .4 ASTM E759-92 (2011), Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
 - .5 ASTM E761-92 (2011), Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
 - .6 ASTM E859-93 (2011), Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC S102-10 Surface Burning Characteristics of Building Materials and Assemblies

- .3 ULC List of Equipment and Materials
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 251-06, Standard Methods of Fire Tests of Building Construction and Materials

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Section 05 05 19 so that steel surfaces meet manufacturer's minimum surface preparation requirements for bond surface, free from wax, grease or other deleterious material that could affect bond of materials specified in this Section, and as follows:
 - .1 Coordinate installation of hangers, inserts, clips and similar items to surfaces needing protection before applying mineral fibre fireproofing.
 - .2 Coordinate installation of ducts, pipes, conduits and similar items that could obstruct spraying operations before applying mineral fibre fireproofing.
 - .3 Coordinate patching of mineral fibre fireproofing after installation of materials installed subsequent to installation of mineral fibre fireproofing.

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data including certified copies of test reports verifying fire resistant material applied to substrate as constructed on project will meet or exceed requirements of specification.
 - .2 Installation Schedule: Submit schedule listing surfaces to which fire resistant material is applied, indicating minimum thickness required a minimum of one month prior to scheduled application of cementitious fireproofing material.
- .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Certificates: Submit test results in accordance with CAN/ULC S101 for fire endurance and CAN/ULC S102 for surface burning characteristics.
 - .1 Delegated Design Submittals: Design intumescent coating thickness required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as follows:
 - .1 Provide manufacturers standard listing where site conditions match standard assembly listings.
 - .2 Provide manufacturers engineered judgment, indicating acceptance by the authorities having jurisdiction, signed and sealed by manufacturer's design engineer, where assembly does not match standard assembly listing.

1.6 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Applicator: Use applicators that are licensed or approved by manufacturer of fire resistant material.
 - .2 Materials: Use materials produced under label service of an agency that has tested material, or assemblies containing material, in accordance with specified test standards.
 - .3 Air Quality: Provide ventilation in areas receiving fire resistant material during and 24 hours after application to dry material; maintain non-toxic, unpolluted working area; provide temporary enclosure to prevent spray from contaminating air.
- .2 Certifications: Provide the following during the course of the Work:
 - .1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver in original undamaged sealed containers with manufacturer's labels, application instructions, and labelling agency's labels intact.
- .2 Storage and Handling Requirements: Store materials in dry protected area, raised off ground and away from damp surfaces and conditions that have deleterious effect on materials; keep materials dry until ready for use; discard material that has been exposed to water before actual use; use stock before its expiration date.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Apply fireproofing materials when temperature of substrate and surrounding air is above manufacturer's minimum temperature, provide sufficient ventilation to aid curing of materials and to maintain air quality requirements.

Part 2 Products

2.1 APPLIED FIREPROOFING

- .1 Design Criteria:
 - .1 Adhesion: Provide materials that meet or exceed adhesion requirements in accordance with ASTM E736.
 - .2 Thickness and Weight: Determine application thickness and weight of mineral fibre fireproofing based on tests of assemblies in accordance with CAN/ULC S101, ASTM E119 or NFPA 251; apply same thickness of fireproofing material to all structural components forming a part of the assembly including; but not limited to, cross bracing, support angles and hangers.
 - .3 Engineered Judgements: Provide engineered judgement acceptable to Authority Having Jurisdiction where assembly being protected differs from the tested assembly used to determine thickness.

- .2 Vermiculite-Gypsum Based Fire Resistant Material: Wet mix spray applied gypsum based fireproofing meeting requirements of ASTM E736, E759, E761 and E859; containing no asbestos fibre, ULC labelled and listed for assemblies and fire ratings indicated on Drawings, and as follows:
 - .1 Dry Density: The field density shall be measured in accordance with ASTM Standard E605. Minimum average density shall be that required by the manufacturer, or as listed in the UL Fire Resistance Directory for each rating indicated, or as required by the authority having jurisdiction, or a minimum average 240 kg/m^3 (15 pcf) whichever is greater.
 - .2 Bond Strength: Fireproofing, when tested in accordance with ASTM E736, shall have a minimum average bond strength of 9.6 kN/m^2 (200 psf) and a minimum individual bond strength of 7.2 kN/m^2 (150 psf).
- .3 Water: Clean, fresh, suitable for domestic consumption, and free from such amounts of mineral or organic substance as would affect set of fire resistant material.
- .4 Accessories: Reinforcement mesh, wire lath and other components necessary for a complete and functioning fireproof coating installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that environmental conditions surfaces receiving mineral fibre fireproofing meet manufacturer's requirements before beginning installation products specified in this Section; installation of products will denote acceptance of site conditions.

3.2 PREPARATION

- .1 Protection of Existing Conditions:
 - .1 Provide and maintain temporary enclosures to prevent spray from marring adjacent construction, close off and seal installed duct work to prevent contamination of air supply system.
 - .2 Provide and maintain masking, drop cloths and polyethylene coverings to protect surfaces exposed in final construction from over spray.
- .2 Surface Preparation:
 - .1 Clean surfaces receiving sprayed fireproofing of oil, grease, dirt, loose paint, mill scale or any other material that could impair bond.
 - .2 Prime surfaces as required by manufacturer to achieve bond of fireproofing materials to substrates.

3.3 APPLICATION

- .1 Apply mineral fibre fireproofing in accordance with manufacturer's written installation requirements and as required to obtain fire resistance ratings indicated for the Project.
- .2 Apply mineral fibre fireproofing in coats not exceeding recommended by manufacturer for fire resistance ratings indicated for the Project.

- .3 Mix each batch of material separately in accordance with manufacturer's instructions to achieve required density and thickness; do not re-temper material or use frozen, caked, or lumpy material.
- .4 Cut, patch, and repair material that does not meet requirements of this Section or which that fails to attain properties stipulated in reports of tests used to determine fire resistance rating of assembly.
- .5 Repair damage to fire resistant material caused by installation of subsequent Work.

3.4 SITE QUALITY CONTROL

- .1 Site Testing and Inspections: Site testing and inspections will be performed in accordance with requirements specified in Section 01 45 00 – Quality Control and as follows:
 - .1 Departmental Representative may appoint third party inspection and testing agency to confirm that installation of mineral fibre fireproofing meets requirements of ASTM E605 and ASTM E736.
 - .2 One series of tests will be performed using both laboratory and site testing for each 1000 m² of floor area sprayed; patch and repair inspection locations after completion of cut tests.
- .2 Non-Conforming Work: Repair deficiencies identified in test results; patch damage to mineral fibre fireproofing caused by other work of the Project before mineral fibre fireproofing is concealed; or if exposed, before substantial performance.

3.5 CLOSEOUT ACTIVITIES

- .1 Cleaning: Remove equipment and clean exposed wall and floor areas to remove deposits of sprayed mineral fibre fireproofing materials after completion of mineral fibre fireproofing work.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements of design, supply and installation of thin film intumescent fire resistant protective coating systems consisting of surface preparation, basecoat and protective decorative finish coat, having a fire resistance rating as indicated on Drawings.

1.2 RELATED REQUIREMENTS

- .1 Section 05 05 19 – Common Work Results for Metalwork Finishing: Coordination of surface preparation and priming requirements for structural steel surfaces and surface exposure classifications for exterior steel.
- .2 Section 05 12 23 – Structural Steel: Coordination with application schedule of intumescent fireproofing and structural steel installation.
- .3 Section 07 81 00 – Applied Fireproofing
- .4 Section 07 84 00 – Firestopping

1.3 REFERENCE STANDARDS

- .1 Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):
 - .1 Coating Materials Guidelines
 - .2 Surface Preparation Guidelines
 - .3 SSPC-PA2, Paint Application Specification No.2 - Measurement of Dry Paint Thickness with Magnetic Gages
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 703-2012, Standard for Fire Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials
- .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 ULC List of Equipment and Materials, latest edition

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Section 05 05 19 so that steel surfaces meet manufacturer's minimum surface preparation requirements for bond surface, free from wax, grease or other deleterious material and that weld flashes are ground smooth ready for work of this Section.

- .2 Sequencing: Sequence work in conjunction with installation of structural steel and finishing materials, sprinkler pipes, HVAC systems and other mechanical systems; steel surfaces having less than 900 mm clear working access may necessitate applying materials to inaccessible surfaces prior to erection of the finished steel members, either at the point of fabrication or on-site prior to erection.

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data indicating product characteristics, performance and limitation criteria.
 - .2 Informational Submittals: Provide the following submittals as work of this Section progresses:
 - .3 Design Submittals: Design intumescent coating thickness required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as follows:
 - .1 Provide manufacturers standard listing where site conditions match standard assembly listings.
 - .2 Provide manufacturers engineered judgment, indicating acceptance by the Authority Having Jurisdiction, signed and sealed by manufacturer's design engineer, where assembly does not match standard assembly listing.
 - .3 Design thickness of intumescent fire resistant system to provide a fire resistance rating for time period indicated on drawings for columns and beams in accordance with Metric Steel Mass/Heated Perimeter (M/D) calculations.
 - .4 Certification: Submit written certification indicating performance requirements required by Authorities Having Jurisdiction for listed fire resistance rating.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Products supplied and installed by this section shall be manufactured under testing requirements acceptable to the Authority Having Jurisdiction, and packaged in containers indicating ULC compliance label.
- .2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturer: Company specializing in manufacturing products specified in this section for a minimum of five (5) years.
 - .2 Applicator: Use applicator that is approved, licensed and supervised by the manufacturer of fire resistant materials; applicator shall have a minimum three (3) years documented experience in work of similar extent and complexity.
- .3 Certifications: Provide the following during the course of the Work:
 - .1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction for required fire resistance rating.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials in original, undamaged, sealed containers with manufacturer's labels and seals intact.
- .2 Storage and Handling Requirements: Store materials at manufacturer's recommended temperature in a dry, protected area, elevated off ground, and as follows:
 - .1 Protect from freezing.
 - .2 Do not store in direct sunlight.
 - .3 Check Freeze Watch indicators before accepting delivery of materials.
 - .4 Discard any materials that have come into contact with contaminants prior to actual use.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Apply intumescent fire resistant materials when temperature of substrate and surrounding air is above manufacturer's minimum temperature requirement accounting for effects of humidity and wind.

Part 2 Products

2.1 INTUMESCENT FIRE RESISTANT MATERIALS

- .1 Interior Decorative Steel Coating: Site applied intumescent, thin film, fire resistive coating system meeting design requirements and tested in accordance with CAN/ULC S101, and as follows:
 - .1 Fire Rating: As indicated on Drawings
 - .2 Primer: Manufacturer's recommended primer for application to steel surfaces exposed to exterior conditions.
 - .3 Base Coat: Thin film intumescent mastic coating applied in thickness required to meet design fire rating based on steel section properties; requiring no mesh, to provide architecturally smooth finish ready for top coating and having minimum Shore D Hardness of 80.
 - .4 Decorative Top Coat: Manufacturer's recommended decorative top coat, colour as selected by Departmental Representative from standard colour range.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that materials having a high moisture load that could cause excessive humidity and affect application and drying of intumescent coatings are installed and cured before applying materials of this Section.
- .2 Preinstallation Testing: Test surfaces to receive work of this Section and report any defects that may affect the Work of this Section and to confirm compatibility of surfaces to receive fire resistant materials.

3.2 PREPARATION

- .1 Protect adjacent surfaces and equipment from over-spray of sprayed materials.

- .2 Clean substrate free of dust, dirt, grease or other deleterious materials that could affect bond of fire resistance material to substrates.
- .3 Ventilate interior areas during application of work of this Section and 24 hours after application.
 - 1.1.1 Coordinate application of compatible primer to steel prior to shipping to site.

3.3 APPLICATION

- .1 Apply intumescent fire resistant in accordance with manufacturer's instructions in sufficient thickness to achieve fire rating indicated; beginning of application means acceptance of substrate.
- .2 Apply intumescent fire resistant and decorative finish using airless spray equipment to achieve smooth, high gloss finish; orange peel texture and other surface runs or marks arising from painting operations will require remedial action or replacement.

3.4 SITE QUALITY CONTROL

- .1 Departmental Representative will appoint and pay for third party inspection agency in accordance with Section 01 45 00 – Quality Control, to inspect site applied intumescent coatings to:
 - .1 Verify thickness of intumescent fire resistant material, in accordance with SSPC-PA2 and requirements to achieve fire ratings indicated.
 - .2 Inspection will be carried out before application of decorative top coat.
 - .3 Notify Departmental Representative when system is ready for testing a minimum of 48 hours prior to tests being required.

3.5 CLOSEOUT ACTIVITIES

- .1 Patching: Patch and repair any fire resistant material that has been damaged by this or any other section; coordinate cost of repairs with Contractor; costs for repairs will be assessed to Sections of work responsible for damage.
- .2 Cleaning: Remove fire resistant from materials and surfaces not specifically required to be fire rated; remove excess material, over spray, droppings and debris.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-07, Standard Methods of for Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .3 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

1.2 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Continuity of Fire Separations: NBC 2010, Division B, Parts 3.1.8 and 3.1.9.1, 9.10.9):
 - .1 Wall, partition or floor assemblies required to be a fire separation shall be: constructed as a continuous element; have a fire resistance rating; have openings protected by a closure; and have penetrations sealed by a firestop.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details should accurately reflect actual job conditions.

- .4 Samples:
 - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
 - .1 Test reports: in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
 - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: person specializing in fire stopping installations with 5 years documented experience.
 - .2 All fire stopping material shall be from one manufacturer.
 - .3 All fire stopping installation work for entire project shall be by a single contractor experienced in firestopping. Individual disciplines shall NOT fire stop their own work.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN/ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
- .2 Service penetration assemblies: systems tested to CAN/ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN/ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
 - .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
-

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Edge of floor slabs at curtain wall.
 - .3 Top of fire-resistance rated masonry and gypsum board partitions.
 - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .7 Openings and sleeves installed for future use through fire separations.
 - .8 Around mechanical and electrical assemblies penetrating fire separations.
 - .9 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials, preparation and application for caulking and sealants.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .2 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Manufacturer's product to describe.
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit samples in accordance with Section 01 33 00.
- .4 Submit duplicate samples of each type of material and colour.
- .5 Cured samples of exposed sealants for each color where required to match adjacent material.
- .6 Submit manufacturer's instructions in accordance with Section 01 33 00.
 - .1 Instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00.
 - .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.
-

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .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 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .7 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.
- .8 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.
- .9 Fold up metal banding, flatten, and place in designated area for recycling.

1.6 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4°C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
 - .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .3 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
-

Part 2 PRODUCTS

2.1 SEALANT MATERIALS

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

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Silicones One Part.
 - .1 To CAN/CGSB-19.13, primerless, Type S, Grade NS, Class 25, SWRI validated.
- .2 Acrylic Latex One Part.
 - .1 To CAN/CGSB-19.17.
- .3 Acoustical Sealant.
 - .1 To ASTM C919, primerless, Type S, Grade NS, Class 25, SWRI validated.

2.3 SEALANT SELECTION

- .1 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): Sealant type: Silicones One Part.
- .2 Seal interior perimeters of exterior openings as detailed on drawings: Sealant type: Silicones One Part.
- .3 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): Sealant type: Silicones One Part.
- .4 Joints at tops of non-load bearing masonry walls at the underside of poured concrete: Sealant type: Acrylic Latex One Part and Acoustical Sealant.
- .5 Perimeter of bath fixtures (e.g. sinks, tubs, urinals, stools, waterclosets, basins, vanities): Sealant type: Silicones One Part and Acrylic Latex One Part.

2.4 JOINT CLEANER

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

Part 3 EXECUTION

3.1 PROTECTION

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

3.2 SURFACE PREPARATION

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

3.3 PRIMING

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

3.4 BACKUP MATERIAL

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

3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

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

- .3 Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653-10/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM B29-03(2009), Standard Specification for Refined Lead.
 - .3 ASTM B749-03(2009), Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
 - .4 ASTM E330-02(2010), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - .5 ASTM E413-10, Classifications for Rating Sound Insulation.
 - .6 ASTM E1332-10a, Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
 - .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.
 - .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-12, Standard for Fire Doors and Other Opening Protectives.
 - .2 NFPA 252-12, Standard Methods of Fire Tests of Door Assemblies.
 - .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
 - .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .4 CAN/ULC-S702-09-AM1 (R2012), Standard for Thermal Insulation, Mineral Fibre, for Buildings.
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- .5 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
 - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
 - .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 for ratings specified or indicated.
 - .4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC-S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data: in accordance with Section 01 33 00.
- .3 Provide shop drawings: in accordance with Section 01 33 00.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware and fire rating and finishes.
 - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings , reinforcing and fire rating finishes.
 - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
 - .5 Submit test and engineering data, and installation instructions.
- .4 Provide samples in accordance with Section 01 33 00.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.5 QUALITY ASSURANCE

- .1 Manufacturer: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer, and as follows:
 - .1 Fabricate work of this Section to meet the requirements of the Canadian Steel Door and Frame Manufacturer's Association, Manufacturing Specification for Doors and Frames as a minimum, and as further modified in this section.
 - .2 Fabricator shall be a member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.
- .2 Supplier: Obtain hollow metal doors and frames from single source of supply and from a single manufacturer.
- .3 Installer: Use installers who are experienced with the installation of hollow metal doors and frames of similar complexity and extent to that required for the Project.
- .4 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:
 - .1 Steel Fire Rated Doors and Frames: Labelled and listed by an organization accredited by Standards Council of Canada for ratings specified or indicated.
 - .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
 - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
 - .2 Fabricate all rated doors, frames and screens to labelling authority standard.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement: to CAN/CSA- G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction:
 - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
- .2 Stiffened: face sheets welded, honeycomb for uninsulated and insulated core.
 - .1 Fibreglass: to CAN/ULC-S702, semi-rigid , minimum density 24 kg/m³.

- .2 Expanded polystyrene: CAN/ULC-S701, Type 4, density 16 to 32 kg/m³.
- .3 Polyurethane: to CAN/ULC-S704 rigid, modified poly/isocyanurate, closed cell board, density 32 kg/m³.

2.3 ADHESIVES

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

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Section 09 91 23, and 09 91 13. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior top caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Metallic paste filler: to manufacturer's standard.
- .5 Sealant: 07 92 00.
- .6 Glazing: 08 80 50.
- .7 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
 - .2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 1.98 mm welded type construction.
- .4 Interior frames: 1.6 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

- .6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .7 Manufacturer's nameplates on frames and screens are not permitted.
- .8 Conceal fastenings except where exposed fastenings are indicated.
- .9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .10 Insulate exterior frame components with polyurethane insulation.

2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass openings as indicated.
 - .2 Exterior doors: honeycomb construction. Interior doors: honeycomb construction.
 - .3 Fabricate doors with longitudinal edges locked seamed, adhesive assisted. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
 - .4 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
 - .5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
 - .6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
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- .7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .9 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form face sheets for exterior doors from 2.0 mm sheet steel with polystyrene or polyurethane core laminated under pressure to face sheets.
- .2 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

2.12 HOLLOW STEEL CONSTRUCTION

- .1 Form face sheets for exterior doors from 2.0 mm sheet steel.
- .2 Form face sheets for interior doors from 1.6 sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with fibreglass core.
- .5 Fill voids between stiffeners of interior doors with honeycomb core.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air and vapour membrane.

3.4 DOOR INSTALLATION

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

3.5 FINISH REPAIRS

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

3.6 GLAZING

- .1 Install glazing for doors in accordance with Section 08 80 50.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A568/A568M-03, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
 - .2 ASTM A591/A591M-98 Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight (Mass) Applications
 - .3 ASTM A653/653M-04a, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, General Requirements
 - .4 ASTM A1008/A1008M-12, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - .5 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .6 ASTM C36/C36M-03, Standard Specification for Gypsum Wallboard
- .2 National Fire Protection Agency (NFPA):
 - .1 NFPA 80, Standard for Fire Doors and Fire Windows.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for access door components 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 Province of Ontario, Canada.
 - .2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 1 of each type of hand entry access door.
 - .4 Submit one 300 x 300 mm corner sample of each type of body entry door.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual.
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1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect access doors from nicks, scratches, and blemishes.
 - .3 Apply temporary protective coating to finished surfaces. Remove coating after installation.
 - .1 Use coatings in accordance with manufacturer's written instructions that are easily removable.
 - .2 Leave protective coating in place until final cleaning of building.
 - .4 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 NON-RATED ARCHITECTURAL ACCESS PANELS

- .1 Flush doors and trimless frames, fabricated as follows:
 - .1 Aluminum Extrusions: ASTM B221, alloy 6063-T6.
 - .2 Door: Extruded aluminum frame with gypsum board inlay and structural nylon corner elements:
 - .1 Gypsum Board: to ASTM C36, 13 mm and 16 mm thickness to match adjacent construction.
 - .2 Size: Square sized to suit access requirements if not indicated on Drawings.
 - .3 Latch: Flush cam latch operated by tamper-resistant torx drive.
 - .4 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .5 Edge Bead: Recessed extruded aluminum frame edge bead providing surface that can be finished to adjacent gypsum board.
 - .6 Accessories: Fibreglass reinforced nylon, zinc plated screws, stainless steel springs and retaining wire to manufacturer's standard.
 - .7 Finish: Aluminum frames, gypsum board, nylon and aluminum cam latch to receive the same finish and paint as the surrounding surface.

2.2 FIRE RATED ACCESS PANELS IN GYPSUM BOARD

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
 - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
 - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM A591/A591M, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
 - .3 Door: Flush panel, minimum thickness of 0.95 mm.
 - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
 - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .6 Automatic Closer: Spring type
- .2 Edge Beads: Edge trim formed from 0.80 mm nominal thickness zinc coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- .3 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.

2.3 FIRE RATED ACCESS PANELS IN MASONRY OR CONCRETE

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
 - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
 - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM A591/A591M, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
 - .3 Door: Flush panel, minimum thickness of 0.95 mm.
 - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
 - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
 - .6 Automatic Closer: Spring type.
 - .7 Edge Trim: All purpose exposed flange formed from 1.98 mm nominal thickness zinc coated steel sheet.
 - .8 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.

2.4 FABRICATION

- .1 Provide access door assemblies manufactured as integral units ready for installation.

- .2 Provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness for metal surfaces exposed to view in the completed Work.
- .3 Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- .4 Latching Mechanisms: Supply number required to hold doors in flush, smooth plane when closed based on size of door or panel opening.
- .5 Apply manufacturer's standard protective coating on aluminum that will come in contact with concrete after fabrication.

2.5 FINISHES

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- .2 Finish metal fabrications after assembly.
- .3 Aluminum Finishes:
 - .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - .2 As-Fabricated Finish: AA-M10 Mechanical Finish: as fabricated, unspecified (mill finish).
- .4 Steel Finishes:
 - .1 Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For zinc coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780.
 - .2 Factory Priming for Site Painted Finish: Apply shop primer immediately after cleaning and pre-treating, as follows:
 - .1 Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems and capability to provide a sound foundation for site-applied topcoats despite prolonged exposure.
 - .2 Shop Primer for Zinc Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat
 - .3 Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access door 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.

3.2 INSTALLATION

- .1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
 - .1 Install masonry surfaces: in accordance with Section 04 20 00.
 - .2 Install gypsum board surfaces: in accordance with Section 09 21 16.
- .2 Comply with manufacturer's written instructions for installing access doors and frames.
- .3 Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- .4 Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.
- .5 Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of interior all glass entrances.

1.2 DEFINITIONS

- .1 Equal Dimensions: Entrance system assemblies indicating equal dimensions on the Drawings shall be calculated to align with in-place structural elements followed by even division of the space between structural elements. This shall mean that entrance system materials are evenly spaced between adjacent structural members, not necessarily evenly spaced across the entire wall assembly.

1.3 REFERENCE STANDARDS

- .1 American Architectural Manufacturer's Association (AAMA):
 - .1 AAMA 611-98, Voluntary Specification for Architectural Anodized Aluminum
- .2 American National Standards Institute (ANSI):
 - .1 BHMA A156.4-2008, Door Closers
 - .2 BHMA A156.8-2005, Door Controls - Overhead Stops and Holders
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A666-03, Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
 - .2 ASTM B209/209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .3 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .4 ASTM B429-06, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 - .5 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
 - 1.1.1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - .2 Shop Drawings: Submit shop drawings indicating fabrication and installation details including, but not limited to, the following:
 - .1 Plans, elevations, and sections
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- .2 Details of fittings and glazing
- .3 Hardware quantities, locations, and installation requirements
- .3 Samples: Submit samples for each type of exposed finish specified for verification by the Departmental Representative as follows:
 - .1 Metal Finishes: 150 mm long sections of patch fittings, rails, and other items.
 - .2 Glass: 150 mm square panels indicating exposed edge finish.

1.5 SITE CONDITIONS

- .1 Site Measurements: Verify actual locations of structural supports for all glass entrances systems by site measurements before fabrication and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating all glass entrances systems where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

- .1 Manufacturer's Warranty: Provide manufacturer's standard form of warranty covering repair or replacement components of all glass systems that fail in materials or workmanship within a period of two (2) years from date of Substantial Performance; failure of performance requirements will be considered to include; but not be limited to, the following:
 - .1 Deflection exceeding specified limits
 - .2 Framing members transferring stresses, including those caused by structural movements, to glazing.
 - .3 Noise or vibration created by structural movements
 - .4 Loosening or weakening of fasteners, attachments, and other components.
 - .5 Sealant failure
 - .6 Failure of operating units to function properly

Part 2 Products

2.1 MATERIALS

- .1 Tempered Glass: In accordance with CAN/CGSB-12.1 and as follows:
 - .1 Thickness: 12 mm
 - .2 Type: 2 - Tempered.
 - .3 Class: B - Float Glass.
 - .4 Colour: Clear.
 - .5 Category: II - 540 J impact resistance.
 - .6 Edges:
 - .1 Exposed Edges: Flat polished.
 - .2 Butt Edges: Flat ground.

- .2 Aluminum: Materials recommended by manufacturer for type of use and finish indicated, and as follows:
 - .1 Sheet and Plate: In accordance with ASTM B209/B209M, and ANSI H35.1 AA1100-H14, or AA5005-H32 or H34, anodizing quality.
 - .2 Extruded Bars, Rods, Profiles, and Tubes: In accordance with ASTM B221, and ANSI H35.1 AA6063-T5 or T6, anodizing quality.
 - .3 Extruded Structural Pipe and Tubes: In accordance with ASTM B429, and ANSI H35.1 AA6061-T6 or AA6063-T6, anodizing quality.
 - .4 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.
 - .5 Welding Rods and Bare Electrodes: CSA W59.2.
- .3 Stainless Steel Cladding: In accordance with ASTM A 666, Type 302 or 304 as standard with manufacturer; #4 directional satin finish.

2.2 SLIDING DOOR SYSTEM

- .1 Fittings:
 - .1 Patch Fittings: Aluminum.
- .2 Guide Rails:
 - .1 Material: Stainless steel clad aluminum.
 - .2 Mount: Top hung with built in rollers and stops
 - .3 Style: Flat top, square profile.
- .3 Sliding Door Hardware: Manufacturer's standard for sliding action indicated and with twin rollers; bottom rolling door type.
- .4 Anchors and Fastenings: Concealed.

2.3 ACCESSORY MATERIALS

- .1 Bituminous paint: Isolation coating, acid and alkali resistant asphaltic paint in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing MPI#35.
- .2 Structural sealant: Clear structural glazing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N, and ASTM C920, Type S, Grade P, Class 25, use T, M.

2.4 FABRICATION

- .1 Provide holes and cut outs in glass to receive hardware, fittings, rails, and accessories before tempering glass; do not cut, drill, or make other alterations to glass after tempering:
 - .1 Fully temper glass using horizontal process and fabricate with roll wave distortion parallel with bottom edge of door or lite when installed.
 - .2 Factory assemble components and factory install hardware to greatest extent possible.

2.5 ALUMINUM FINISHES

- .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- .2 Clear Anodized Finish:
 - .1 Class II Finish: Architectural Class II, clear coating 0.010 mm or thicker in accordance with AAMA 611.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install all glass systems and associated components in accordance with manufacturer's written instructions.
- .2 Set units level and plumb.
- .3 Maintain uniform clearances between adjacent components.
- .4 Maximum 13 mm sealant space between structural sealant glazed system and adjacent construction.
- .5 Install structural sealant glazing system in accordance with manufacturer's instructions.
- .6 Lubricate hardware and other moving parts in accordance with manufacturer's written instructions.
- .7 Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

3.3 ADJUSTING AND CLEANING

- .1 Adjust doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.
- .2 Remove excess sealant and glazing compounds and dirt from surfaces.
- .3 Wash glass on both faces not more than four (4) days prior to declaration of Substantial Performance for the project.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
 - .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA CW-10-04, Care and Handling of Architectural Aluminum From Shop to Site.
 - .2 AAMA CW-11-85, Design Wind Loads and Boundary Layer Wind Tunnel Testing.
 - .3 AAMA T1R-A1-04, Sound Control for Fenestration Products.
 - .4 AAMA 501-05, Methods of Test for Exterior Walls.
 - .5 AAMA 611-98, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
 - .6 AAMA 612-02, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
 - .7 AAMA 2603-02, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - .8 AAMA 2604-05, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - .3 ASTM International
 - .1 ASTM A36/A36M-08, Specification for Carbon Structural Steel.
 - .2 ASTM A123/A123M-09, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A167-99(2009), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .4 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM B209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .6 ASTM B221-08, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .7 ASTM E283-04, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .8 ASTM E330-02(2010), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
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- .9 ASTM E331-00(2009), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .10 ASTM E413-10, Classification for Rating Sound Insulation.
- .11 ASTM E1105-00(2008), Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint.
 - .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
- .5 CSA International
 - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.
 - .3 CAN/CSA-S157-05/S157.1-05, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.
 - .4 CSA W59.2-M1991(R2008), Welded Aluminum Construction.
- .6 Society for Protective Coatings (SSPC)
 - .1 SSPC - Paint 20-02(R2004), Zinc Rich Coating, Type I - Inorganic and Type II - Organic.
 - .2 SSPC - Paint 25 - 97(R2004) BCS, Zinc Oxide, Alkyd, Linseed Oil and Primer for Use Over Hand Cleaned Steel Type 1 and Type 2.
- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor, Subcontractor, Departmental Representative, and other Subcontractors affected by work of this Section in accordance with Section 01 31 19 to:
 - .1 Review structural load limitations and deflection criteria of adjacent construction, support systems and curtain wall system.
 - .2 Review installation and substrate and structure conditions affecting work of this Section.
 - .3 Review requirements of this Section for connection to substrates and structures provided by other Sections.
 - .4 Review of metal fabrications, anchors and fasteners required by and provided by this Section to other components of the work.

- .5 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .6 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria and technical requirements indicated on the shop drawings.
- .7 Review written installation instructions and warranty requirements.
- .8 Review other or additional installation requirements not otherwise covered by the suggested listing of topics.
- .2 Coordination: Coordinate installation of curtain wall system with work specified in other Sections to ensure correct placement and installation of vapour barrier, insulation and flashing to maintain continuity of building air, vapour and thermal barrier and to divert moisture and water to the exterior, and as follows:
 - .1 Coordinate installation of sealants so that ambient and surface temperatures are greater than 5°C from time of application until sealants have cured.
 - .2 Coordinate connection of curtain wall system structural connections to horizontal building structures and vertical members.
 - .3 Coordinate design of curtain wall elements to tie into adjacent building envelope elements.
 - .4 Coordinate fabrication of miscellaneous steel, anchorages and fasteners required by curtain wall system for complete installation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for curtain wall components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain wall systems clearly indicating all construction details including the following:
 - .1 Connections and anchor requirements
 - .2 Metal fabrications integral with aluminum curtain wall system installation
 - .3 Type, size and spacing of fastening devices
 - .4 Design loads
 - .5 Connections to adjacent air and vapour membranes
 - .6 Internal drainage and sealant locations
 - .7 Seal of a professional engineer registered in the Province of the Work for details requiring structural design for load bearing, or life and health safety
 - .8 Other detailed requirements for installation.

- .3 Delegated Design Submittals:
 - .1 Include framing member structural and physical characteristics, calculations, dimensional limitations, special installation requirements.
- .4 Informational Submittals: Provide the following:
 - .1 Qualification Statement: Submit evidence of welder qualifications specified in this Section when requested by Departmental Representative.
 - .2 Source Quality Control Submittals: Submit delegated design professional engineer's design notes and calculations when requested by Departmental Representative.
 - .3 Manufacturer's Installation Instructions: Submit manufacturer's installation instructions for transition membrane assembly when requested by Departmental Representative.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Installer shall be capable of assuming delegated design engineering responsibility, performing Work of this Section and who is acceptable to manufacturer for the type of work specified.
 - .2 Delegated Design Professional: Retain a Professional Engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including the following:
 - .1 Seal and signature to shop drawings and design submittals
 - .2 Site review of installed components
- .2 Certifications: Provide the following during the course of the Work:
 - .1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Handle work of this Section in accordance with AAMA CW-10.
 - .2 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
-

- .3 Store and protect aluminum glazed curtain wall components from nicks, scratches, and blemishes.
- .4 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- .5 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return to manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

1.7 AMBIENT CONDITIONS

- .1 Install sealants when ambient and surface temperature is above 5 °C minimum.
- .2 Maintain this minimum temperature during and for 48 hours minimum after installation of sealants.

Part 2 PRODUCTS

2.1 SYSTEMS

- .1 Description:
 - .1 Vertical glazed aluminum curtain wall system includes thermally broken tubular aluminum sections with self supporting framing, shop fabricated, factory prefinished, vision glass, spandrel infill; related flashings, anchorage and attachment devices.
 - .2 Assembled system to permit re-glazing of individual glass (and infill panel) units from exterior without requiring removal of structural mullion sections.
- .2 Performance Requirements:
 - .1 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system to a design pressure of 0.37 kPa 1/50 year occurrence in accordance with Building Code.
 - .2 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable codes.
 - .3 Deflection Normal to Wall Plane: Limited to L/175 of clear span for spans up to 4100 mm, and to L/240 of clear span plus 6 mm or spans greater than 4100 mm or an amount that restricts edge deflection of individual glazing lites to 19 mm, whichever is less.
 - .4 Deflection Parallel to Glazing Plane: Limited to amount not exceeding an amount that reduces glazing bite to less than 75% of design dimension and that reduces edge clearance between framing members and glazing or other fixed components to less than 3 mm.
 - .5 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
 - .6 Ensure system is designed to accommodate the following without damage to components or deterioration of seals:
 - .1 Movement within system.
 - .2 Movement between system and perimeter framing components.

- .3 Dynamic loading and release of loads.
- .4 Deflection of structural support framing.
- .5 Shortening of building concrete structural columns.
- .6 Creep of concrete structural members.
- .7 Air Infiltration: Design system for maximum air leakage of 0.3 L/m^2 of fixed wall area when tested in accordance with ASTM E283 at a minimum static air pressure differential of 300 Pa.
- .8 Vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40% RH: no failure.
- .9 Water leakage: none, when measured to ASTM E331.
- .10 Ensure system allows for expansion and contraction within system components when temperature range is 95°C over 12 hour period without causing detrimental affect to system components.
- .11 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
- .12 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
 - .1 Position thermal insulation on exterior surface of air barrier and vapour retarder.
- .13 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .14 Reinforce curtain wall system to accommodate window washing guide rails.
 - .1 Supply sufficiently rigid anchors to resist loads caused by equipment platform, without damage to wall system.

2.2 MATERIALS

- .1 Extruded aluminum: to ASTM B221.
- .2 Sheet aluminum: to ASTM B209.
- .3 Steel sections: to CSA G40.20/G40.21; shaped to suit mullion sections.
- .4 Anchors: 3-way adjustable hot-dip galvanized cast iron.
- .5 Fasteners: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- .6 Bituminous paint: CAN/CGSB-1.108, without thinner and formulated for 0.76 mm thickness per coat.
- .7 Fire Safety Materials: see Section 07 84 00.
- .8 Sealant: As specified in Section 07 92 00.
 - .1 Type: Single component neutral curing silicone meeting requirements of ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O
 - .2 Joint Movement Capability: Accommodate 50% increase or decrease in joint width at time of application when measured according to ASTM C719.

- .3 Colour: Standard colour selected by Departmental Representative.
- .9 Transition Membranes: Full length self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements and compatible with materials specified in Section 07 25 13.
- .10 Break formed 3 mm aluminum closure pieces as indicated on details.

2.3 COMPONENTS

- .1 Frame Type (CW1): To profiles and thicknesses required to meet performance criteria; but not less than 3 mm thickness, and as follows:
 - .1 Frame Dimensions: Nominal 63.4 mm wide x 168.4 mm deep back section having a 28 mm glazing throat for a total nominal frame depth of 196.4 mm.
 - .2 Cover Depth: Nominal 63.4 mm wide x 19 mm deep.
- .2 Frame Type (CW2): To profiles and thicknesses required to meet performance criteria; but not less than 3 mm thickness, and as follows:
 - .1 Frame Dimensions: Nominal 63.4 mm wide x 133.4 mm deep back section having a 28 mm glazing throat for a total nominal frame depth of 161.4 mm.
 - .2 Cover Depth: Nominal 63.4 mm wide x 19 mm deep.
- .3 Frame Type (CW3): To profiles and thicknesses required to meet performance criteria; but not less than 3 mm thickness, with horizontal structural silicone glazing joints and as follows:
 - .1 Frame Dimensions: Nominal 50 mm wide x 100 mm deep back section having a 28 mm glazing throat for a total nominal frame depth of 128 mm.
 - .2 Cover Depth: Nominal 50 mm wide x 19 mm deep.
- .4 Insulated Spandrel Panels:
 - .1 Spandrel Glass: Specified in Section 08 80 50.
 - .2 Spandrel Panel Inserts: Composite metal faced flat panels having maximum 0.8% deviation in surface plane for total width and length and as follows:
 - .1 Exterior Skin: Aluminum as follows:
 - .1 Thickness: 1.6 mm.
 - .2 Finish: Matching framing system.
 - .3 Texture: Smooth.
 - .4 Backing Sheet: 3 mm thick tempered hardboard.
 - .2 Interior Skin: Aluminum as follows:
 - .1 Thickness: Manufacturer's standard for finish and texture indicated
 - .2 Finish: Matching curtain wall framing.
 - .3 Texture: Smooth.
 - .4 Backing Sheet: 3 mm thick tempered hardboard
 - .3 Back Pan: Galvanized steel in accordance with ASTM A653, 0.91 mm base metal thickness.

- .4 Insulation: Rigid mineral fibre insulation held in place with manufacturer's standard fixing system to back face of back pan.

2.4 OPERABLE UNITS

- .1 Door:
 - .1 Construction: Standard narrow stile, thermally broken frame sections.
 - .1 Dimensions: Nominal 45 mm deep.
 - .2 Glazing Method: Square stops for sealed glazing with non-removable glazing stops on outside of door.
 - .3 Hardware: Manufacturer's standard hardware.

2.5 FABRICATION

- .1 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof
- .3 Prepare components to receive anchor devices. Install anchors.
- .4 Arrange fasteners and attachments to ensure concealment from view.
- .5 Prepare system components to receive exterior doors and hardware.
- .6 Reinforce framing members for external imposed loads.
- .7 Visible manufacturer's identification labels not permitted.
- .8 Infill Panels:
 - .1 Fabricate infill panels with metal covered edge seals around perimeter of panel assembly, enabling installation and minor movement of perimeter seal.
 - .2 Reinforce interior surface of exterior panel sheet from deflection caused by wind and suction loads.
 - .3 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
 - .4 Place insulation within panel, adhered to exterior face of interior panel sheet over entire area of sheet with impale fasteners.
 - .5 Ventilate and pressure equalize the air space outside the exterior surface of the insulation, to the exterior.
 - .6 Arrange fasteners and attachments to ensure concealment from view.
- .9 Finishes:
 - .1 Clear Anodized Finish:
 - .1 Class I Finish: Architectural Class I, clear coating 0.018 mm or thicker in accordance with AAMA 611.

2.6 SOURCE QUALITY CONTROL

- .1 Manufacturer qualifications: company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.

- .2 Installer qualifications: company specializing in performing the work of this section with minimum 5 years documented experience and as approved by manufacturer.
- .3 Design structural support framing components to CAN/CSA-S157/S157.1 under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located in the Province of Ontario.
- .4 Perform welding Work in accordance with CSA W59.2.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum curtain wall installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Verify dimensions, tolerances, and method of attachment with other work.
 - .3 Verify wall openings and adjoining air barrier and vapour retarder materials are ready to receive work of this Section.
 - .4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install curtain wall system in accordance with manufacturer's instructions.
- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Use alignment attachments and shims to permanently fasten system to building structure. Clean weld surfaces; apply protective primer to field welds and adjacent surfaces.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
- .5 Use thermal isolation where components penetrate or disrupt building insulation.
- .6 Co-ordinate installation of fire stop insulation, specified in Section 07 84 00, at each floor slab edge and intersection with vertical construction where indicated.
- .7 Co-ordinate attachment and seal of perimeter air barrier and vapour retarder materials.
- .8 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- .9 Install fire-safing in areas as indicated.
- .10 Install operating sash in accordance with Section 08 80 50, to glazing method required to achieve performance criteria.
- .11 Erection Tolerances: Install glazed aluminum curtain wall systems in accordance with the following maximum tolerances:

- .1 Plumb: 3 mm in 3000 mm; 6 mm in 12 m cumulative.
- .2 Level: 3 mm in 6000 mm; 6 mm in 12 m cumulative.
- .3 Alignment: Limit offsets from true alignment as follows:
 - .1 1.5 mm where surfaces abut in line or are separated by reveal or protruding element up to 13 mm wide.
 - .2 3 mm where surfaces are separated by reveal or protruding element from 13 mm to 25 mm wide.
 - .3 6 mm where surfaces are separated by reveal or protruding element of 25 mm wide or greater.
- .12 Location: Limit variation from plane to 3 mm in 3600 mm; 13 mm over total length.
- .13 Install glass and infill panels in accordance with Section 08 80 50, to glazing method required to achieve performance criteria. Place sealant on the up-slope side of the pressure plate cover caps; finish the surface with a slope to encourage drainage over the cap.
- .14 Install perimeter sealant to method required to achieve performance criteria.

3.3 FIELD QUALITY CONTROL

- .1 Structural Sealant Compatibility and Adhesion: Test structural in accordance with recommendations of ASTM C 1401 and as follows:
 - .1 Destructive test method, Method A, Hand Pull Tab (Destructive) in ASTM C1401, Appendix X2 shall be used:
 - .1 Repair installation areas damaged by testing.
 - .2 Structural Sealant Glazing Inspection: Inspect structural sealant glazing and evaluate in accordance with ASTM C1401 recommendations after installation of aluminum framed entrance and storefront systems is complete.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer of curtain wall and or glass verifying compliance of Work, in handling, installing, applying, protecting and cleaning of products, and submit written reports in acceptable format to verify compliance of Work with Contract within 3 days of review.
 - .2 Submit 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 Ensure manufacturer's representative of curtain wall and of glass is present before and during critical periods of installation.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.4 ADJUSTING

- .1 Adjust operating hardware for smooth operation in accordance with hardware manufacturers' written instructions.
- .2 Adjust closers designated as accessible for people with disabilities to provide a 3 second closer sweep period for doors to move from a 70° open position to 75 mm from latch measured to the leading door edge.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove protective material from prefinished aluminum surfaces.
 - .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
 - .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
 - .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2006, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2011, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.4-2008, Door Controls - Closers.
 - .4 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .5 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
 - .6 ANSI/BHMA A156.13-2012, Mortise Locks and Latches Series 1000.
 - .7 ANSI/BHMA A156.15-2008, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
- .2 Canadian Steel Door Manufacturers' Association (CSDFMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
-

- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
 - .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping strippable coating.
 - .4 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 HARDWARE ITEMS

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

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, series 4000 bored lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
 - .2 Interconnected locks and latches: to ANSI/BHMA A156.12, series 5000 interconnected lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
 - .3 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
-

- .4 Lever handles: plain design.
- .5 Roses: round.
- .6 Normal strikes: box type, lip projection not beyond jamb.
- .7 Cylinders: key into keying system as directed.
- .8 Finished to C26D.
- .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
- .3 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule, size in accordance with ANSI/BHMA A156.4, table A1, finished to C26D.
 - .2 Door controls - overhead holders: to ANSI/BHMA A156.8, designated by letter C and numeral identifiers listed in Hardware Schedule, finished to C26D
 - .3 Closer/holder release devices: to ANSI/BHMA A156.15, designated by letter C and numeral identifiers listed in hardware schedule, finished to C26D.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

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

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Departmental Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
-

.2 Repair damage to adjacent materials caused by door hardware installation.

3.5 SCHEDULE

Hardware Group No. 01

For use on mark/door #(s):
P100

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1	EA	EXIT DEVICE	CD-35A-EO (Grade 1, Type 4, Function 01)	626	ANSI
1	EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1	EA	RIM ELECTRIC STRIKE	6111 FSE DS (E59321)	630	ANSI
1	EA	PULL	7009-1 X TB	630	CBH
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
1	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	EA	ACTUATOR, WALL MOUNT	8310-852WP	630	LCN
1	EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1	EA	WEATHER SEAL	BY ALUM FRAME SUPPLIER	AL	MIC

Hardware Group No. 02 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P101

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	EXIT DEVICE	CD-98-NL-OP-110 (Grade 1, Type 1, Function 03)	630	ANSI
1	EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1	EA	RIM CYLINDER	20-021 (E09221)	626	ANSI
1	EA	RIM ELECTRIC STRIKE	6111 FSE DS (E59311)	630	ANSI
1	EA	DOOR PULL	J401 X TB	630	CBH
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
2	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 03 - RE-USE EXISTING HARDWARE

For use on mark/door #(s):
P101A

Provide each SGL door(s) with the following:

Hardware Group No. 04

For use on mark/door #(s):
P104

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 05 - CARD ACCESS

For use on mark/door #(s):
P105

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
2	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 06

For use on mark/door #(s):
P106

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 07

For use on mark/door #(s):
P106A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 NRP (A8112)	652	ANSI

1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 08

For use on mark/door #(s):
P107

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 09

For use on mark/door #(s):
P108

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 10 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P109-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
2	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 11

For use on mark/door #(s):
ST01-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	FIRE EXIT DEVICE	98-L-F-996-02 (Grade 1, Type 1, Function 08)	630	ANSI
1	EA	RIM CYLINDER	20-021 (E09221)	626	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	SMOKE SEAL	W-21 (2 X H, 1 X W)	BLK	KNC
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

CONTROLLED EGRESS

Hardware Group No. 12

For use on mark/door #(s):
ST01-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1	EA	EXIT DEVICE	CD-98-EO (Grade 1, Type 1, Function 01)	630	ANSI
1	EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1	EA	WEATHER SEAL	R3Y155 (2 X H, 1 X W)	AL	KNC
1	EA	SWEEP	R3A155 X DR WIDTH	AL	KNC
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 13 - CARD ACCESS

For use on mark/door #(s):
P109-3

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 14

For use on mark/door #(s):
P110

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 15

For use on mark/door #(s):
P111-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 NRP (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	SMOKE SEAL	W-21 (2 X H, 1 X W)	BLK	KNC

Hardware Group No. 16

For use on mark/door #(s):
P111-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	SMOKE SEAL	W-21 (2 X H, 1 X W)	BLK	KNC

Hardware Group No. 17

For use on mark/door #(s):
P112

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 NRP (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI

1 EA KICK PLATE J102 200 X SIZE TO SUIT 630 CBH

Hardware Group No. 18

For use on mark/door #(s):
P113

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 19 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P114-1

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
4 EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1 EA	EXIT DEVICE	CD-35A-EO (Grade 1, Type 4, Function 01)	626	ANSI
1 EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1 EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1 EA	DOOR PULL	J401 X TB	630	CBH
1 EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1 EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1 EA	WEATHER SEAL	BY ALUM FRAME SUPPLIER	AL	MIC
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 20 - CARD ACCESS

For use on mark/door #(s):
P114-2

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1 EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1 EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 21 - CARD ACCESS

For use on mark/door #(s):

P115-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 22

For use on mark/door #(s):

P116

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	SET	SOUND SEAL	CT-42 (1XW - 2XH)	AL	KNC
1	EA	DOOR BOTTOM	CT-52 X DR WIDTH	AL	KNC

Hardware Group No. 23

For use on mark/door #(s):

P117 P124

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 24

For use on mark/door #(s):

P118 P119 P121 P122

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1 EA	INSTITUTION LOCK	L9082P 02A (F30)	630	ANSI
1 EA	CONCEALED OH STOP	100S (C01541)	630	ANSI

Hardware Group No. 25

For use on mark/door #(s):
P120

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1 EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 26

For use on mark/door #(s):
P125 P126

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	PASSAGE SET	L9010 02A (F01)	630	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 27

For use on mark/door #(s):
P127

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1 EA	EXIT DEVICE	CD-98-NL-OP-110 (Grade 1, Type 1, Function 03)	630	ANSI
1 EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1 EA	RIM CYLINDER	20-021 (E09221)	626	ANSI
1 EA	DOOR PULL	J401 X TB	630	CBH
1 EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1 EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1 EA	WEATHER SEAL	R3Y155 (2 X H, 1 X W)	AL	KNC
1 EA	SWEEP	R3A155 X DR WIDTH	AL	KNC
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 28 - CARD ACCESS

For use on mark/door #(s):

P128-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1	EA	EXIT DEVICE	CD-98-NL-OP-110 (Grade 1, Type 1, Function 03)	630	ANSI
1	EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1	EA	RIM CYLINDER	20-021 (E09221)	626	ANSI
1	EA	RIM ELECTRIC STRIKE	6111 FSE DS (E59311)	630	ANSI
1	EA	DOOR PULL	J401 X TB	630	CBH
1	EA	CONCEALED OH STOP & HOLDER	100H (C01511)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
2	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852WP	630	LCN
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1	EA	WEATHER SEAL	R3Y155 (2 X H, 1 X W)	AL	KNC
1	EA	SWEEP	R3A155 X DR WIDTH	AL	KNC
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 29 - CARD ACCESS BY SECURITY

For use on mark/door #(s):

P128-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 30 - CARD ACCESS BY SECURITY

For use on mark/door #(s):

P128-3

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI

1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 31

For use on mark/door #(s):

P129 P134-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 32

For use on mark/door #(s):

P130 P131 P133

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
2	EA	MANUAL FLUSH BOLT	FB458 (L04251)	626	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
2	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
2	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 33

For use on mark/door #(s):

P134-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 34

For use on mark/door #(s):
P134-A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 35 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P136-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGE	3CB1HW 114 X 114 NRP (A5111)	630	ANSI
1	EA	EXIT DEVICE	CD-35A-EO (Grade 1, Type 4, Function 01)	626	ANSI
1	EA	MORTISE CYLINDER	20-001 114 XQ11-947 (E09211)	626	ANSI
1	EA	RIM ELECTRIC STRIKE	6111 FSE DS (E59311)	630	ANSI
1	EA	DOOR PULL	J401 X TB	630	CBH
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	SURF. AUTO OPERATOR	9542 HL/D MS (C0Unknown)	ANCLR	ANSI
1	EA	ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	EA	ACTUATOR, WALL MOUNT	8310-852WP	630	LCN
1	EA	THRESHOLD	J32130 X OPENING WIDTH	AL	KNC
1	EA	WEATHER SEAL	BY ALUM FRAME SUPPLIER	AL	MIC
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 36 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P136-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	FIRE EXIT DEVICE	98-L-F-996-02 (Grade 1, Type 1, Function 08)	630	ANSI
1	EA	RIM CYLINDER	20-021 (E09221)	626	ANSI
1	EA	RIM ELECTRIC STRIKE	6111 FSE DS (E59311)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 37 - CARD ACCESS BY SECURITY

For use on mark/door #(s):

P137-1 P137-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 38 - CARD ACCESS BY SECURITY

For use on mark/door #(s):

P138

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI
1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 39

For use on mark/door #(s):

P138A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 40

For use on mark/door #(s):
P139

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 41

For use on mark/door #(s):
P140

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 42

For use on mark/door #(s):
P140A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 43 - CARD ACCESS BY SECURITY

For use on mark/door #(s):
P228 ST01-3 ST02-1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 NRP (A8111)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A XL11-422 (F07)	630	ANSI

1	EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	SMOKE SEAL	W-21 (2 X H, 1 X W)	BLK	KNC
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 44

For use on mark/door #(s):

P202	P203	P204	P207	P210	P213
P214	P216	P217	P225	P226	P227

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	FLOOR STOP	FS436 (L12141)	626	ANSI

Hardware Group No. 45

For use on mark/door #(s):

P208

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 NRP (A8112)	652	ANSI
1	EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1	EA	CONCEALED OH STOP	100S (C01541)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

Hardware Group No. 46

For use on mark/door #(s):

P211-1 P211-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	PASSAGE SET	L9010 02A (F01)	630	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	FLOOR STOP	FS436 (L12141)	626	ANSI

Hardware Group No. 47

For use on mark/door #(s):

P211A

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 48

For use on mark/door #(s):
P212

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	STOREROOM W/DEADBOLT	L9480P 02A	630	SCH
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 49 - CARD / CODE ACCESS BY SECURITY

For use on mark/door #(s):
P215

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1 EA	ELECTRIC STRIKE	6211 FSE DS (E59321)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1 EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 50

For use on mark/door #(s):
P220

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	FLOOR STOP	FS436 (L12141)	626	ANSI

Hardware Group No. 51

For use on mark/door #(s):

P222 P223

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 52

For use on mark/door #(s):

P222A

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 53

For use on mark/door #(s):

P224

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1 EA	STOREROOM W/DEADBOLT	L9480P 02A	630	SCH
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 54

For use on mark/door #(s):

A101 A138 A139 A141 A147 A150
A152A

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI

1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	FLOOR STOP	FS436 (L12141)	626	ANSI

Hardware Group No. 55

For use on mark/door #(s):

A115 A151

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Hardware Group No. 56

For use on mark/door #(s):

A116

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 57

For use on mark/door #(s):

A128 A128A A129 A129A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	DOOR PULL	J401 X TB	630	CBH
1	EA	PUSH PLATE	923A 125 x 500	630	CBH
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 58

For use on mark/door #(s):
A128B A129B

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	EA	PRIVACY W/DB & IND	L9496P OCCUPIED/VACANT 02A	630	SCH
1	EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 59 - RELOCATE EXISTING DOOR & FRAME

For use on mark/door #(s):
A137 A144 A149B

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA		REUSE EXISTING HARDWARE		MIS

Hardware Group No. 60 - EXISTING DOOR & FRAME

For use on mark/door #(s):
B116

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA		REUSE EXISTING HARDWARE		MIS
1	EA	DOOR CORD	788-18		SCE
1	EA	ELECTRIC STRIKE	TO SUIT EXISTING DOOR (E09731)	630	ANSI

Hardware Group No. 61

For use on mark/door #(s):
A148

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1	SET	PUSH-PULL	7009-1 X BTB	630	CBH
1	EA	H-SEC CLOSER - PUSH SIDE	4211T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1	EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 62

For use on mark/door #(s):

GATE GATE 1 GATE 2 GATE 3

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
1 EA		COMPLETE BY GATE SUPPLIER		MIS

Hardware Group No. 63

For use on mark/door #(s):

A202

Provide each PR door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
6 EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
2 EA	MANUAL FLUSH BOLT	FB458 (L04251)	626	ANSI
1 EA	STOREROOM LOCK	L9080P 02A (F07)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
2 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
2 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 64

For use on mark/door #(s):

A203

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1 EA	CLASSROOM LOCK	L9070P 02A (F32)	630	ANSI
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH
1 EA	WALL STOP	WS407CVX (L52101)	630	ANSI

Hardware Group No. 65

For use on mark/door #(s):

A203A A203B

Provide each SGL door(s) with the following:

Qty	Description	Catalog Number	Finish	Mfr
4 EA	HINGE	3CB1HW 114 X 114 (A8111)	652	ANSI
1 EA	DOOR PULL	J401 X TB	630	CBH
1 EA	PUSH PLATE	923A 125 x 500	630	CBH
1 EA	H-SEC CLOSER - PULL SIDE	4511T AVB (C02Unknown1 PT-4A, PT-4C, PT-4D, PT-4H, PT-4J)	689	ANSI
1 EA	KICK PLATE	J102 200 X SIZE TO SUIT	630	CBH

1	EA	FLOOR STOP	FS436 (L12141)	626	ANSI
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Hardware Group No. 66

For use on mark/door #(s):

A203C-1 A203C-2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 114 X 102 (A8112)	652	ANSI
1	EA	OFFICE/ENTRY LOCK	L9050P 02A (F04)	630	ANSI
1	EA	FLOOR STOP	FS436 (L12141)	626	ANSI

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C542-05, Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - .3 ASTM D1003-07e1, Standard Test Method for Haze and Luminous Transmittance of Plastics.
 - .4 ASTM D1929-96(R2008)e1, Standard Test Method for Determining Ignition Temperature of Plastics.
 - .5 ASTM D2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness.
 - .6 ASTM E84-10b, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .7 ASTM E330-02(2010), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - .8 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.
 - .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
 - .4 CAN/CGSB-12.4-M91, Heat Absorbing Glass.
 - .5 CAN/CGSB-12.8-97, Insulating Glass Units.
 - .6 CAN/CGSB-12.8-97 (Amendment), Insulating Glass Units.
 - .7 CAN/CGSB-12.9-M91, Spandrel Glass.
 - .8 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.
 - .9 CAN/CGSB-12.11-M90, Wired Safety Glass.
 - .3 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual 50th Anniversary Edition-2008.
 - .2 GANA Laminated Glazing Reference Manual - 2009.
 - .3 GANA Sealant Manual-2008.
 - .4 GANA Laminated Glazing Reference Manual (2009).
 - .5 GANA Guide to Architectural Glass (2010).
 - .6 GANA/PGC International Protective Glazing Manual (2010).
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1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor's Representative and Departmental Representative in accordance with Section 01 31 19 to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit two (2) 75 mm x 125 mm size samples of spandrel glass.
 - .4 Submit two (2) 75 mm x 125 mm size samples of sealed glass unit.
 - .5 Submit two (2) samples of frosted glass 100 mm x 100 mm sample indicating range of transparency using material selected from initial sample selection process; submit prior to fabrication.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .1 Submit testing and analysis of glass under provisions of Section 01 45 00.
 - .2 Submit shop inspection and testing for glass.

1.4 CLOSEOUT SUBMITTALS

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

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .1 Regulatory Requirements:
 - .1 Fire Rated Glass Glazing: Provide Glass Glazing materials meeting specified fire ratings, tested and labelled in accordance with requirements acceptable to Authority Having Jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
 - .3 Protect prefinished aluminum surfaces with wrapping.
 - .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return to manufacturer of pallets, crates, padding and packaging materials as specified in accordance with Section 01 74 20.

1.7 AMBIENT CONDITIONS

- .1 Ambient Requirements:
 - .1 Install glazing when ambient temperature is 10 °C minimum. Maintain ventilated environment for 24 hours after application.
 - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Design Criteria:
 - .1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
 - .2 Limit glass deflection to 1/175 with full recovery of glazing materials.
 - .2 Flat Glass:
 - .1 Float glass: to CAN/CGSB-12.3, clear glass no tint.
 - .2 Tinted Glass: Manufactured in accordance with CAN/CGSB-12.4 and as follows:
-

- .1 Glass Quality: Float glass, glazing quality.
- .2 Type:
 - .1 Single Pane Applications: Type 1
 - .2 Insulating Glass Applications: Type 2
- .3 Class: B - Heat strengthened or Class C - Tempered as required to prevent thermal shock breakage
- .4 Tint: Colour to be selected by Departmental Representative from manufacturers extended colour range.
- .3 Safety glass: to CAN/CGSB-12.1 and ASTM C1048, heat soaked in accordance with EN14179-1, transparent.
 - .1 Type 2-tempered.
 - .2 Class B-float.
 - .3 Category II- Fully Tempered.
 - .4 Roller Wave Tolerance: Notwithstanding requirements of ASTM C1048, limit distortions arising from tempering process to a maximum nominal 0.08 mm peak to valley at centre of glass and 0.20 mm within 265 mm of leading and trailing edges of the glass.
- .4 Laminated Safety Glass: In accordance with CAN/CGSB-12.1 and ASTM C1172.
 - .1 Clear, tempered glass
 - .2 Type 1 – laminated
 - .3 Class B – float
 - .4 Category II - Fully Tempered
 - .5 Exposed Edge Alignment: Not withstanding requirements of ASTM C1172; grind and polish edges before assembly and heat treatment to minimize mismatch of exposed edges to a tolerance not exceeding +1.25 mm / -0.00 mm; align patterns and roller wave to the greatest extent possible to reduce moiré effect; Standard Tolerances listed in ASTM C1172 apply to glass having non-exposed edges.
- .5 Frosted Glass: Clear acid etched glass
 - .1 Type: : 2 – Tempered
 - .2 Class: B - Float Glass
 - .3 Roller Wave Tolerance: Notwithstanding requirements of ASTM C1048, limit distortions arising from tempering process to a maximum nominal 0.08 mm peak to valley at centre of glass and 0.20 mm within 265 mm of leading and trailing edges of the glass.
 - .4 Category: II - Fully Tempered
- .6 Silvered mirror glass:
 - .1 Type 1B-float glass for high humidity use.
 - .2 Tint: Clear
 - .3 Edges: Pencil polished edge. Seal edges to prevent chemical or atmospheric penetration of backing.

- .7 Spandrel glass: to CAN/CGSB-12.9.
 - .1 Type 2-heat strengthened.
 - .2 Class A-float.
 - .3 Style 3- applied silicone elastomeric coating, minimum thickness 0.13 mm
 - .4 Form M-monolithic.
 - .5 Colour: To be selected by Departmental Representative from manufacturer's extended colour range.
 - .8 Wired glass: to CAN/CGSB-12.11.
 - .1 Type 1-polished both sides (transparent).
 - .2 Wire mesh styles 3-square.
 - .9 Low emissivity (LOW E) glass: to CAN/CGSB-12.10
 - .1 Metallic coating: soft, sputtered.
 - .2 Light transmittance: 70%.
 - .3 Shading co-efficient: 0.43.
 - .4 Solar Heat Gain Coefficient: 0.37
 - .5 U-Value: winter 1.40 W/m²/C maximum, summer 1.27 W/m²/C maximum.
 - .3 Insulating Glass Units:
 - .1 Tinted Insulating glass units: to CAN/CSGSB-12.8, double unit
 - .1 Exterior lite: Tinted heat strengthened or tempered, having high performance Low E coating on #2 surface.
 - .2 Air space: 12 mm Argon filled
 - .3 Interior Lite: Clear heat strengthened or tempered glass.
 - .2 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.
 - .1 Use two stage seal method of manufacture, as follows:
 - .1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator.
 - .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.
 - .3 Install stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location when required by manufacturer; seal tube immediately prior to installation in accordance with glass fabricator's written instructions.
 - .4 Spacer/ Separator: Glass Fabricator's standard stainless steel; coloured black, spacer containing desiccant, sealed to provide continuous vapour barrier between interior of sealed unit and secondary seal.
 - .4 Sealant: in accordance with Section 07 92 00.
-

2.2 GLASS BALUSTRADES

- .1 Laminated Tempered Glass: Out Picked at source, silvering quality laminated tempered glass having minimal inclusions exceeding the requirements of CAN/CGSB-12.1-M90, and as follows:
 - .1 Modulus of Rupture: 165.48 MPa when tested in accordance with ASTM C1036
 - .2 Edges:
 - .1 Ground with no chips, cracks or flaws
 - .2 Sharp corners and edges eased and polished
 - .3 Total Thickness: 16 mm
 - .4 Laminating Film:
 - .1 Material: Polyvinyl Butyral (PVB)
 - .2 Minimum film thickness: 1.50 mm
- .2 Colour: Clear

2.3 ACCESSORIES

- .1 Setting blocks: silicone, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .2 Spacer shims: silicone, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.
- .3 Glazing Compound: For glazing to metal, in accordance with CAN/CGSB 19.2.
- .4 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.
- .5 Glazing tape:
 - .1 100% polybutalene vehicle. Extruded in ribbon form with paper separator. Tape shall have an integral shim strip where required.
- .6 Lock-strip gaskets: to ASTM C542.
- .7 Mirror attachment accessories:
 - .1 Stainless steel clips.
 - .2 Mirror adhesive, chemically compatible with mirror coating and wall substrate.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
 - .1 Verify that openings for glazing are correctly sized and within tolerance.
 - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
 - .3 Visually inspect substrate in presence of Departmental Representative.

- .4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- .1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid.
- .2 Do not glaze when ambient or surface temperatures are less than 4°C. Glazing rebates, stops and glass shall be dry, free from ice, frost slick, grease, oil, dust, rust, or other matter detrimental to adhesion of tape, glazing compounds and sealant.
- .3 Installation of glass shall be by workmen skilled in this trade in strict accordance with manufacturer's directions, to produce a first class installation.
- .4 Position sealed units to provide minimum 12 mm glass bite, and minimum 6 mm perimeter clearance between glass and framing.
- .5 Glass shall be free from contact with the frames and stops.
- .6 Label each light to show manufacturer's name or trade mark, quality and thickness.
- .7 Glaze interior doors with foam or cork tape on both sides. – For wired glass, use glazing tape. – Trim tape even with the sight line.
- .8 Use sealant at exterior doors, sealing water and weather tight.
- .9 Mirrors: Secure mirrors with a minimum of 4 clips per piece; provide pads to prevent direct metal-to-glass contact of clips or screws as follows:
 - .1 Align mirrors; in multiple application, to a parallel and true plane surface to produce a true reflection across all sections.
 - .2 Place plumb and level.
- .10 Sealed Units: Install sealed units in accordance with fabricator's written instructions, taking care not to warp or twist glass to prevent stress or breaking of glass seals and as follows:
 - .1 Crimp capillary breather tube in accordance with fabricator's written instructions, and as follows:
 - .1 Do not trim sealant from around base of tube.
 - .2 Do not pull or attempt to remove the tube.
 - .3 Crimp tube immediately prior to installing sealed unit by placing pliers perpendicular to tube 25 mm from end of tube.
 - .4 Do not permit tube to be exposed to or sit in water.

- .5 Cover tube with stainless steel strip and set in sealant bead compatible with insulated glass sealants.
- .11 Wired Glass: Install wired glass to locations indicated and as follows:
 - .1 Install wired glass where glazing is indicated in fire resistant closures (e.g. fire doors, steel framed openings in fire rated walls).
 - .2 Install wired glass with wires parallel to frame opening.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .1 Remove traces of primer, caulking.
 - .2 Remove glazing materials from finish surfaces.
 - .3 Remove labels.
 - .4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
 - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International
 - .1 ASTM C473-10, Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - .2 ASTM C475-02(2007)/C475M-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .3 ASTM C514-04(2009)e1, Standard Specification for Nails for the Application of Gypsum Board.
 - .4 ASTM C557-03(2009)e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - .5 ASTM C840-11, Standard Specification for Application and Finishing of Gypsum Board.
 - .6 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
 - .7 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants.
 - .8 ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - .9 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .10 ASTM C1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .11 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .12 ASTM C1178/C1178M-11, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
 - .13 ASTM C1278/C1278M-07a, Standard Specification for Fiber-Reinforced Gypsum Panel.
 - .14 ASTM C1280-11, Standard Specification for Application of Gypsum Sheathing.
 - .15 ASTM C1288-99(2010), Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets.
 - .16 ASTM C1325-08b, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
 - .17 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
 - .18 ASTM D1037-12, Standard Test Methods for Evaluating Properties of Wood-Based Fiber and Particle Panel Materials

- .19 ASTM D5420-10, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
- .20 ASTM D2394-05(2011), Standard Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring.
- .21 ASTM E90-09 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .22 ASTM E695-03(2009) Standard Method for Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
- .23 ASTM E2638-10 Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.
- .3 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish 101a-97.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.
- .7 American National Standards Institute (ANSI)
 - .1 ANSI A118.9-1992, Test Methods and Specifications for Cementitious Backer Units.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DESIGN REQUIREMENTS

- .1 Partition assembly to be non-combustible construction.
 - .2 Minimum sound transmission rating of installed panel partition to be STC 30, tested to ASTM E90.
 - .3 Minimum speech privacy category SPC Standard Speech Privacy 60-65 tested to ASTM E2638.
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1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store gypsum board assemblies materials level off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
 - .3 Protect from weather, elements and damage from construction operations.
 - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .5 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
 - .6 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return to manufacturer of pallets, crates, padding and packaging materials as specified in accordance with Section 01 74 20.

1.5 AMBIENT CONDITIONS

- .1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Standard board: to ASTM C1396/C1396M, regular, thickness as indicated on drawings and fire-rated type X, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, long edges tapered.
- .2 Sag Resistant Gypsum Board: to ASTM C1396/C1396M, thickness as indicated on drawings, 1200 mm wide x maximum practical length.
- .3 Abuse Resistant Gypsum Board to ASTM C1396/C1396M, thickness as indicated on drawings, 1200 wide x maximum practical length.
 - .1 Indentation Resistance: ASTM D1037 or D5420 to provide 2.54 mm maximum indentation at 45 N.
 - .2 Soft Body Impact Resistance: ASTM E695 to produce failure using a 22.7 kg bag when dropped from a minimum height of 838 mm.
- .4 Exterior Sheathing: Glass matt faced gypsum based sheathing to ASTM C1177, thickness as indicated on drawings, 1200 mm wide x maximum practical length.

- .5 Glass Mat Faced Mould Resistant Gypsum Backer Panels: Glass mat faced gypsum board to ASTM C1658/C1658M with mould resistant facers meeting a rating of 10 (zero mould growth) in accordance with ASTM D3273, 15.9 mm thickness, to maximum practical length.
- .6 Metal furring runners, hangers, tie wires, inserts, anchors: to ASTM C645.
- .7 Drywall furring channels: 0.80 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .8 Resilient furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .9 Nails: to ASTM C514.
- .10 Steel drill screws: to ASTM C1002.
 - .1 Type S: Shallow pitch screw; used for single layer gypsum board application
 - .2 Type G: Steep pitch screw; used for double layer gypsum board application
- .11 Stud adhesive: to CAN/CGSB-71.25.
- .12 Laminating compound: as recommended by manufacturer, asbestos-free.
- .13 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, Metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .14 Sealants: in accordance with Section 07 92 00.
- .15 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .16 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .17 Joint compound: to ASTM C475/C475M, asbestos-free.
- .18 Joint tape: to ASTM C475/C475M. Type as recommended by gypsum board manufacturer for type of installation; use only mould resistant materials for mould and moisture resistant materials.

2.2 FINISHES

- .1 Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies 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.

3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.
- .7 Install 19 x 64mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw, unless otherwise indicated.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners. Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using stud adhesive. Maximum spacing of screws 300 mm on centre
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

- .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
 - .2 Double-Layer Application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
 - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
 - .3 Apply base layers at right angles to supports unless otherwise indicated.
 - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
 - .3 Apply single layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
 - .1 Comply with gypsum board manufacturer's recommendations.
 - .2 Brace or fasten gypsum board until fastening adhesive has set.
 - .3 Mechanically fasten gypsum board at top and bottom of each sheet.
 - .4 Apply mould-resistant gypsum board where wall tiles to be applied and adjacent to slop sinks and janitors closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
 - .5 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.
 - .6 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
 - .7 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
 - .8 Install gypsum board with face side out.
 - .9 Do not install damaged or damp boards.
 - .10 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.
 - .11 Install wood blocking and sheet metal wall backing continuously where reinforcement is required for wall hung accessories and assemblies and as follows:
 - .1 Butt joints between adjoining metal sheets
 - .2 Form sheet metal extending 150 mm on each side of wall and ceiling corners without joints where metal backing is continuous around corners
 - .3 Spot glue first gypsum board layer at 150 mm ^{o/c} to metal backing to hold in place before mechanically fastening surface layer of gypsum board in a two layer installation.
-

3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .6 Provide continuous polyethylene dust barrier behind and across control joints.
- .7 Install control joints in wall and ceiling construction in accordance with ASTM C840 so that gross area enclosed by joints does not exceed 80 m² between joints using limiting distances as follows:

Partition Type	Maximum Single Dimension
Interior Partitions	9 metres
Interior Ceilings with Perimeter Relief	15 metres
Interior Ceilings without Perimeter Relief	9 metres

- .8 Install control joints straight and true.
- .9 Splice corners and intersections together and secure to each member with 3 screws.
- .10 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .11 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .12 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
 - .1 Levels of finish:
 - .1 Level 0: Not Used
 - .2 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.
 - .3 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
 - .4 Level 3: Not Used

- .5 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
- .6 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.
- .13 Gypsum Board Application and Finishing Standards: ASTM C840 and generally at the following locations and as indicated on Drawings:
 - .1 Regular Type: Vertical surfaces not subject to wetting
 - .2 Fire Resistant Type: Where required for fire resistance rated assemblies; fire resistant description can modify any of the following gypsum board types
 - .3 Sag Resistant Type: Overhead and horizontal surfaces not subject to wetting
 - .4 Abuse Resistant Type: As indicated on Drawings
 - .5 Tile Backing Type: Where required for surfaces receiving tile or other surface finishes
- .14 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .15 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .16 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .17 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .18 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .19 Mix joint compound slightly thinner than for joint taping.
- .20 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .21 Allow skim coat to dry completely.
- .22 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .2 ASTM C645-11a, Standard Specification for Nonstructural Steel Framing Members.
 - .3 ASTM C754-11, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .4 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
 - .5 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants.
 - .6 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .7 ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.
 - .8 ASTM E413-10, Classification for Rating Sound Insulation.
 - .9 ASTM F1267-07, Standard Specification for Metal, Expanded, Steel.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S702-09, Standard for Thermal Insulation Mineral Fibre for Buildings.

1.2 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.
- .4 Partition assembly to be non-combustible construction and fire resistance rated.
- .5 Sound Transmission Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency for STC ratings of specific assemblies indicated on Drawings.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
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- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Divert unused gypsum materials from landfill to recycling facility approved by Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Steel Suspended Ceiling Framing: Provide components and materials in accordance with ASTM C754 for interior conditions as indicated on Drawings, and as follows:
 - .1 Tie Wire: ASTM A641 Class 1 zinc coating, soft temper, No. 12 gauge wire.
 - .2 Hangers:
 - .1 Wire Hangers: ASTM A641, Class 1 zinc coating, soft temper, No. 8 gauge.
 - .2 Rod Hangers: ASTM A510, mild carbon steel; 6 mm Ø minimum; ASTM A153, hot dip galvanized.
 - .3 Flat Hangers: Commercial steel sheet, ASTM A653, Z180, hot dip galvanized; 5 mm x 25 mm x length required.
 - .3 Carrying Channels: Cold rolled, commercial steel sheet with a base metal thickness of 1.2 mm x 13 mm minimum wide flange, with ASTM A653, Z180, hot dip galvanized zinc coating; 38 mm minimum depth.
 - .4 Furring Channels: Commercial steel sheet with ASTM A653, Z180, hot dip galvanized zinc coating, as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.45 mm thickness x 22 mm deep.
 - .2 Resilient Furring Channels: 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .2 Steel Partition Framing: Provide components and materials in accordance with ASTM C754, modified with CSSBI recommended wall height limitations for composite wall construction listed in Lightweight Steel Framing Architectural Design Guide for interior non-load bearing partitions and conditions indicated on Drawings.
- .3 Steel Sheet Components, Steel Studs and Runners: In accordance with ASTM C645 requirements for metal and with ASTM A653, Z180, hot dip galvanized zinc coating and as follows:
 - .1 Steel Studs: Nominal 0.45 mm base metal thickness, except use 0.80 mm heavy weight framing to support fire rated door frames, and supporting abuse resistant gypsum board; depth as indicated on drawings.
 - .2 Runners: Width, thickness and galvanizing to match steel studs, and as follows:

- .1 Slotted Deflection Track: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm ^o/c along length of runner; tested and certified for use in fire rated wall construction and have a ULC or cUL_{US} labelled assembly for fire rated assemblies
- .2 Double Runner Deflection Track for Non-Rated Assemblies: Outside runner using 75 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.
- .3 Base Runner: Bottom track with 33 mm upstanding legs.
- .3 Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated; 1.2 mm nominal base metal thickness x 406 mm wide.
- .4 Horizontal Cross Bracing: 1.2 mm nominal base metal thickness; 13 mm minimum width flange x 38 mm minimum depth.
- .5 Clip Angle: 38 mm x 38 mm x 1.8 mm nominal base metal thickness
- .6 Furring Channels: Commercial steel sheet with ASTM A653, Z180, hot dip galvanized zinc coating, as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.80 mm thickness x 22 mm deep.
 - .2 Resilient Furring Channels: 0.45 mm thickness x 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .7 Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- .4 Heavy Gauge Interior Partition Framing: Steel stud framing for walls exceeding 2440 mm and having full height tile finish and walls supporting abuse resistant gypsum board, and phenolic panels, and as follows:
 - .1 Cold Formed Sheet Steel: Provide commercial steel sheet interior members; not forming a part of the exterior building envelope, having a minimum ASTM A653, Z180, hot dip galvanized zinc coating, thickness of framing members exclusive of galvanized coating.
 - .2 Studs: Meeting requirements of CAN/CSA S136; identified for type, grade and mechanical properties; minimum 92 mm deep x 38mm wide x metal core thickness 0.80 mm spaced at 600 mm on centre, hot dipped galvanized steel; roll formed with knurled flanges, services and bracing cut outs.
 - .3 Track: Meeting requirements of CAN/CSA S136 having minimum metal core thickness 0.80 mm, hot dipped galvanized steel and as follows:
 - .1 Top track flanges of depth to suit vertical deflection; do not fix top of studs to track; width to suit studs; single top track system.
 - .2 Floor track to suit stud width, with 33 mm flanges.
 - .4 Channel Stiffener: 19 mm cold rolled channel of 1.2 mm, electro-galvanized steel.
 - .5 Fasteners:
 - .1 Stud-to-Stud: Steel, self drilling, self threading, case hardened.
 - .1 Material: stainless steel or steel with minimum 0.008 mm cadmium or zinc coating.
 - .2 Head Profile: hex, pan, and low profile type.

- .3 Length: adequate to penetrate not less than 3 fully exposed threads beyond joined materials.
- .2 Track-to-Concrete: Hilti drilled insert, sizes as specified; do not use powder actuated fasteners.
- .3 Track-to-Steel: Secure track to structural steel over 8 mm thickness using Hilti DX fastening system with X-EDNI nails as specified. Provide additional steel back up above interstitial steel deck for wall support.
- .4 Drilled Inserts: Steel, cadmium plated or hot dip galvanized, sizes as indicated on drawings.
- .6 Bolts and Nuts: Meeting requirements of ASTM A307, with large flat type steel washers, sized to suit fasteners, hot dip galvanized, 413.68 MPa Tensile Strength
- .7 Welding Electrodes: Minimum tensile strength series of 480 MPa, suitable for material being welded.
- .8 Touch-Up Paint: Zinc rich, to CAN/CGSB-1.181.

Part 3 EXECUTION

3.1 ERECTION

- .1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
- .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .4 Place studs vertically at 600 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .5 Erect metal studding to tolerance of 1:1000.
- .6 Attach studs to bottom track using screws.
- .7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .10 Install heavy gauge single jamb studs at openings.
- .11 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .12 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

- .13 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .14 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .15 Extend partitions to ceiling height except where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces.

3.2 INSTALLING STEEL FRAMING

- .1 Installation Standards: ASTM C754, and ASTM C840 requirements that apply to framing installation.
- .2 Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, provideings, or similar construction. In accordance with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with GA, Specification Standards Manual.
- .3 Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement, and as follows:
 - .1 Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - .2 Isolate partition framing and wall furring where it abuts structure, except at floor.
 - .3 Install deflection track at head of assemblies that avoid axial loading of assembly and laterally support assembly, as follows:
 - .1 Non-rated Assemblies: Install double runner deflection track
 - .2 Fire Rated Assemblies: Install slotted deflection track.
- .4 Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- .5 Installing Steel Suspended Ceiling and Soffit Framing: Suspend ceiling hangers from building structure as follows:
 - .1 Install ceiling suspension systems requiring seismic restraint in accordance with ASTM E580/E580M.
 - .2 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system.
 - .3 Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - .4 Install supplemental suspension members and hangers in form of trapezes or similar devices where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members.
 - .5 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - .6 Secure wire hangers by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 - .7 Secure rod, flat or angle hangers to structure; including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail:
 - .1 Do not attach hangers to steel deck tabs.
 - .2 Do not attach hangers to steel roof deck; attach hangers to structural members; provide additional carrier channels between structural elements where structure does not align with hangers.

- .3 Do not connect or suspend steel framing from ducts, pipes, or conduit.
- .8 Install steel framing components for suspended ceilings so members for panel attachment are level to within 3 mm in 3600 mm measured lengthwise on each member and transversely between parallel members.
- .9 Wire-tie furring channels to supports; clips will not be acceptable.
- .10 Install suspended steel framing components in sizes and spacing indicated, but not less than that required by the referenced steel framing and installation standards:
 - .1 Hangers: 1220 mm o/c
 - .2 Carrying Channels (Main Runners): 1220 mm o/c
 - .3 Furring Channels (Furring Members): 406 mm o/c
- .6 Installing Steel Partition Framing: Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction:
 - .1 Install foam gasket isolation strip between studs where studs are installed directly against exterior walls.
 - .2 Fasten to concrete with expansion anchors, shielded screws not exceeding 600 mm o/c. Do not use powder activated fasteners.
 - .3 Install each steel framing and furring member so fastening surfaces vary not more than 3 mm from the plane formed by the faces of adjacent framing.
 - .4 Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board:
 - .1 Cut studs 13 mm short of full height to provide perimeter relief.
 - .2 Install framing around structural and other members extending below floor slabs and roof decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure for fire resistance rated and STC rated partitions that extend to the underside of floor slabs and roof decks or other continuous solid structure surfaces.
 - .3 Terminate partition framing at suspended ceilings where indicated.
 - .5 Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
 - .6 Install horizontal cross bracing to steel studs at 1220 mm o/c vertically for the entire length of wall for unbraced walls exceeding 3660 mm in length.
 - .7 Frame door openings using 0.84 mm steel studs and in accordance with gypsum board manufacturer's applicable written recommendations:
 - .1 Screw vertical studs at jambs to jamb anchor clips on door frame; install runner track section (for cripple studs) at head and secure to jamb studs.
 - .2 Install two studs at each jamb, connected for entire length.
 - .3 Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
 - .8 Frame openings other than door openings the same as required for door openings. Install framing below sills of openings to match framing required above door heads.

- .9 Install double row of resilient channels in sound and fire rated assemblies at long and short (butt) edges of gypsum board panels, and provide a minimum of 38 mm from edge of panel to screw location; coordinate screw installation with other requirements of this Section.

3.3 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
 - .1 ANSI A108.1-99, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).
 - .2 CTI A118.3-92, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).
 - .3 CTI A118.4-92, Specification for Latex Cement Mortar (included in ANSI A108.1).
 - .4 CTI A118.6-92, Specification for Ceramic Tile Grouts (included in ANSI A108.1).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CGSB 71-GP-22M-78(AMEND.), Adhesive, Organic, for Installation of Ceramic Wall Tile.
 - .3 CAN/CGSB-75.1-M88, Tile, Ceramic.
 - .4 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .4 Terrazzo Tile and Marble Association of Canada (TTMAC)
 - .1 Tile Specification Guide 09 30 00 2009/2010, Tile Installation Manual.
 - .2 Tile Maintenance Guide.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data in accordance with Section 01 33 00.
 - .1 Include manufacturer's information on:
 - .1 Ceramic tile, marked to show each type, size, and shape required.
 - .2 Chemical resistant mortar and grout (Epoxy).
 - .3 Divider strip.
 - .4 Leveling compound.
 - .5 Latex cement mortar and grout.
- .3 Provide samples in accordance with Section 01 33 00.
 - .1 Base tile: submit duplicate, sample of each colour, texture, size, and pattern of tile.

- .2 Adhere tile samples to 12 mm thick plywood and grout joints to represent project installation.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance Submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.5 AMBIENT CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 °C for 48 hours before, during, and 48 hours after, installation.
- .2 Do not install tiles at temperatures less than 12 °C or above 38 °C.
- .3 Do not apply epoxy mortar and grouts at temperatures below 15 °C or above 25 °C.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
 - .3 Maintenance material same production run as installed material.

Part 2 PRODUCTS

2.1 FLOOR TILE

- .1 Porcelain tile: to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 10 mm x 300 mm x 300 mm size, slip resistant surface, pattern & colour as indicated on Finish Legend.

2.2 TRIM SHAPES

- .1 Conform to applicable requirements of adjoining floor tile.

2.3 MORTAR AND ADHESIVE MATERIALS

- .1 Cement: to CAN/CSA-A3001, type GU.
- .2 Sand: to ASTM C 144, passing 16 mesh.
- .3 Hydrated lime: to ASTM C 207, Type N.

- .4 Latex additive: formulated for use in cement mortar and thin set bond coat.
- .5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

2.4 BOND COAT

- .1 Latex Cement mortar: to ANSI A108.1, two-component universal dry-set mortar.
- .2 Epoxy bond coat: non-toxic, non-flammable, non-hazardous during storage, mixing, application, and when cured. To produce shock and chemical resistant mortars having the following physical characteristics:
 - .1 Compressive Strength: 246 kg/cm².
 - .2 Bond Strength: 53 kg/cm².
 - .3 Water Absorption: 4.0% Max.
 - .4 Ozone Resistance, 200 hours @ 200 ppm: no loss of strength.
 - .5 Smoke Contribution Factor: 0.
 - .6 Flame Contribution Factor: 0.
 - .7 Finished mortar and grout to be resistant to urine, dilute acid, dilute alkali, sugar, brine and food waste products, petroleum distillates, oil and aromatic solvents.
- .3 Chemical-Resistant Bond Coat:
 - .1 Epoxy Resin Type: CTI A118.3.

2.5 GROUT

- .1 Colouring Pigments:
 - .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C 979.
 - .2 Colouring pigments to be added to grout by manufacturer.
 - .3 Job coloured grout are not acceptable.
 - .4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.
- .2 Latex Cement Grout: to ANSI A108.1, fast curing, high early strength, polymer-modified, stain resistant, sanded mix for floors, unsanded mix for walls and floors with polished tiles commercial tile grout.
- .3 Chemical-Resistant Grout:
 - .1 Epoxy grout: to ANSI A108.1, having quality, colour and characteristics to match epoxy bond coat. Adhesive and grout by same manufacturer.

2.6 ACCESSORIES

- .1 Reinforcing mesh: 50 x 50 x 1.6 x 1.6 mm galvanized steel wire mesh, welded fabric design, in flat sheets.
- .2 Transition Strips: purpose made metal extrusion; anodized aluminum type.
- .3 Reducer Strips: purpose made metal extrusion; anodized aluminum type; maximum slope of 1:2.

- .4 Prefabricated Movement Joints: purpose made, having a Shore A Hardness not less than 60 and elasticity of plus or minus 40 percent when used in accordance to TTMAC Detail 301EJ.
- .5 Sealant: in accordance with Section 07 92 00.
- .6 Floor sealer and protective coating: to CAN/CGSB-25.20, Type 1 to tile and grout manufacturers recommendations.

2.7 MIXES

- .1 Cement:
 - .1 Mortar bed for floors: 1 part cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
 - .2 Levelling coat: 1 part cement, 4 parts sand, minimum 1/10 part latex additive, 1 part water including latex additive.
 - .3 Measure mortar ingredients by volume.
- .2 Adjust water volumes to suit water content of sand.

2.8 PATCHING AND LEVELLING COMPOUND

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:
 - .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
 - .4 Density - 1.9.
- .3 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in 48 hours after application.

2.9 CLEANING COMPOUNDS

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 WORKMANSHIP

- .1 Do tile work in accordance with TTMAC Tile Installation Manual, "Ceramic Tile", except where specified otherwise.
- .2 Apply tile to clean and sound surfaces.
- .3 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .4 Maximum surface tolerance 1:800.
- .5 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .6 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .7 Install divider strips at junction of tile flooring and dissimilar materials.
- .8 Allow minimum 24 hours after installation of tiles, before grouting.
- .9 Clean installed tile surfaces after installation and grouting cured.
- .10 Make control joints in accordance with TTMAC recommendations in each direction. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07 92 00. Keep building expansion joints free of mortar and grout.

3.3 FLOOR SEALER AND PROTECTIVE COATING

- .1 Apply in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

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

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
 - .2 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .3 ASTM D792-00, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- .2 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Confirm acceptable substrate and fastening requirements for work of this Section supplied and installed by other Sections.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's standard product data clearly indicating materials used and methods of installation.
 - .2 Shop Drawings: Submit shop drawings indicating attachment methods, joinery, accommodation of thermal movement, edge conditions, panel joints and reveals, fixture locations, anchorages, accessories, finish colours, patterns and textures; prepare detail drawings at a minimum 1:2 scale and elevations at a minimum 1:100 scale, include proof of CAN/ULC S134 testing for rated assemblies.
 - .3 Samples:
 - .1 Samples for Initial Selection: Manufacturer's colour charts or chips showing the full range of colors, textures, and patterns available for wall panels with factory applied finishes.
 - .4 Samples for Verification:
 - .1 Panels: Submit two (2)-300 mm x 300 mm samples of selected colour before ordering material.
 - .2 Accessories: Submit one (1) sample of clips, caps, battens, fasteners, closures, and other exposed panel accessories used in the final panel assembly.

- .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Certificates: Submit qualification statement or certificate stating that fabricator and installer are approved by manufacturer and have the necessary tools, equipment and expertise to undertake work specified in this Section; include lists of completed projects with project names and addresses, names and addresses of Departmental Representatives and owners indicating range of experience.
 - .2 Source Quality Control Submittals: Submit product test reports indicating compliance of manufactured wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
 - .3 Site Quality Control Submittals: Submit written inspection report indicating compliance with manufacturers requirements for installation and system requirements.

1.4 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning procedures, include names of recommended cleaning agents and precautions against materials and methods detrimental to finishes and performance in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and assemblies meeting requirements of CAN/ULC S102 for flame spread and CAN/ULC S134 for assemblies as required by the Authority Having Jurisdiction.
- .2 Qualifications:
 - .1 Manufacturer: Obtain materials from a single manufacturer having a minimum of five (5) years experience and technical support personnel that can provide technical review to panel fabricator to address specific installation requirements.
 - .2 Fabricator: Use fabricator having shop and equipment required to factory fabricate panels to shapes and configurations indicated, having experience with projects of similar complexity and extent, and certified by manufacturer.
 - .3 Installer: Use an experienced installer who has completed solid phenolic panel installations similar in material, design, and extent to that indicated for this project, and with a record of successful in-service performance.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Schedule delivery of products specified in this section to avoid delaying the Work; deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - .2 Storage and Handling Requirements: Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
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1.7 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

- .1 Manufacturer Warranty: Submit manufacturer's standard 1 year warranty covering loss of colour, and physical and mechanical properties arising from installation, fabrication or manufacture of solid phenolic wall panels; manufacturer's warranty is in addition to; and not a limitation of, other rights contained within the Contract Documents.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Deflection:
 - .1 Maximum deflection criteria apply to horizontal plane of system, width and length, as well as vertical deflection. Ensure that adequate stiffeners and fasteners are included to prevent deflection.

2.2 INTERIOR PANELS

- .1 Solid Phenolic Wall Panels: Flat panel comprised of thermosetting resins homogeneously reinforced with cellulose fibres, manufactured under high pressure and temperature and as follows:
 - .1 Mounting Configuration: Prepare panels for non-exposed fastener installation.
 - .2 Panel Thickness: 8 mm
 - .3 Panel Size: Largest sheet stock practical for fabrication of panels to optimize sheet size to dimensions indicated on Drawings and to minimize off-cuts and waste.
 - .4 Panel Core: Fire Resistant Black Core meeting requirements of CAN/ULC S102.
 - .5 Colour: Selected by Departmental Representative from manufacturer's extended range.
 - .6 Finish: Selected by Departmental Representative from manufacturer's extended range
 - .2 Joints: Anodized, extruded aluminum H-Profile using manufacturer's standard trims.
 - .3 Corner Trims: Manufacturer's standard anodized, extruded aluminum 8 mm radius corner profile.
 - .4 Aluminum Sub-Framing Materials: Aluminum extrusions, mill finish meeting requirements for ASTM B221 alloy 6063-T6 in shapes and sizes selected by fabricator as required to suit design loading and wall configuration.
 - .5 Aluminum Trim and Accessory Materials: Aluminum sheet or plate, anodized finish meeting requirements for ASTM B209M alloy 6063-T6 in configurations and sizes selected by fabricator as required to suit details.
 - .6 Panel Fasteners: Non-corrosive fasteners as recommend by panel manufacturer, and as follows:
-

- .1 Attach panel sub-framing system to primary structural supports using manufacturer's recommended concealed fasteners.
- .2 Attach trims and joint profiles using manufacturer's recommended concealed fasteners for typical joinery.
- .3 Attach panels to sub-framing using manufacturer's standard non-exposed fasteners.
- .4 Obtain Departmental Representative's acceptance where exposed fasteners are required in isolated conditions; Departmental Representative will permit a limited number of exposed fasteners obscured within panel joinery using stainless steel fastenings, or in the face of panels using colour matched fastenings.
- .7 Accessories: Manufacturer's recommended materials required for complete installation.

2.3 FABRICATION

- .1 Fabricate wall panels and components to obtain profiles and details indicated on drawings and as indicated in shop drawings.
- .2 Fabricate components at factory to the greatest extent possible using best shop practices as required by panel manufacturer.

Part 3 Execution

3.1 PREPARATION AND EXAMINATION

- .1 Obtain dimensions from job site before fabricating panels.
- .2 Verify that building surfaces are smooth, clean and dry, and free from defects detrimental to the installation of the system.
- .3 Notify Contractor of conditions not acceptable for installation of system, start of work will indicate acceptance of substrate conditions.
- .4 Inspect all panels and components prior to installation and verify that there is no shipping damage; do not install damaged panels, repair or replace as required for smooth and consistent finished appearance.

3.2 INSTALLATION

- .1 Install sub-framing in accordance with manufacturer's instructions; provide additional framing as may be required to conform to specified performance requirements.
- .2 Install sub-framing attached to structural support or wall framing, using manufacturer's recommended non-exposed fasteners; apply bituminous paint or tape between the dissimilar metals or concrete and aluminum sub-framing materials to isolate against corrosion.
- .3 Install fasteners into wall framing; do not remove fastener where fastener does not penetrate framing; realign fastener location and install new fastener in close proximity to original fastener so that it penetrates wall framing.
- .4 Tolerances:
 - .1 Panel Dimensions: Allow for site adjustment and thermal movement.

- .2 Panel Fabrication: Fabricate panels under controlled shop conditions to the greatest extent possible; site fabrication will only be permitted where minor adjustments are required to account for substrate variations that could not be identified during the preparation of shop drawings.
- .3 Panel Surfaces: Free of scratches or marks caused during fabrication and installation.
- .4 Panel Bow: Maximum 0.8% of any 3050 mm panel overall dimension in width or length.
- .5 Panel Flatness: Provide sufficient fastenings in accordance with manufacturers recommendations for specified panel thickness to maintain non-cumulative flatness.
- .6 Panel Joints: 10 mm \pm 0.5 mm joint width between any 2 adjacent panels, vertical or horizontal; 0 mm lippage where 2 adjacent panels share the same sub-framing member; 1 mm lippage where 2 adjacent panels do not share the same sub-framing member.

3.3 SITE QUALITY CONTROL

- .1 Perform final inspection of completed work shall carried out by the manufacturer's representative; prepare a written report and submit to Departmental Representative certifying that installation meets manufacturers requirements and detailing for systems described in this Section.

3.4 CLOSEOUT ACTIVITIES

- .1 Repair or Replacement:
 - .1 Remove and replace panels that are damaged and cannot be repaired; coordinate with Contractor for responsibility of repairs not caused by work of this Section.
 - .2 Touch-up damaged finishes with manufacturer's recommended touch-up paint; touch-up painting will only be permitted where damaged finishes are visible in final installation.
- .2 Cleaning:
 - .1 Remove strippable film coating or masking as soon as possible after surrounding material is installed.
 - .2 Remove excess materials, debris, and equipment at completion.
 - .3 Clean all panels clean and free of all grime and dirt.

3.5 PROTECTION

- .1 Protect installed materials and finish surfaces from damage by other subcontractors for the duration of construction.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C423-06, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM C635/C635M-12, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - .3 ASTM C636-06, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustic Tile and Lay-In Panels
 - .4 ASTM E580/E580M-11b, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay in Panels in Areas Subject to Earthquake Ground Motions
- .2 Ceilings & Interior Systems Construction Association (CISCA):
 - .1 CISCA Ceiling Systems Handbook.
- .3 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate layout and installation of acoustic wood ceiling and suspension system with other construction that penetrates ceilings or is supported by them including; but not limited to, light fixtures, HVAC equipment, fire suppression system, and partition assemblies, and as follows:
 - .1 Schedule and coordinate installation of ceiling to occur after completion of overhead mechanical and electrical work.
 - .2 Schedule and coordinate ceiling installation with mechanical and electrical trades building in components into ceiling finish panels.
- .2 Pre-Installation Conference: Conduct conference at Project site in accordance with requirements of Section 01 31 19 to discuss coordination issues with Contractor, Subcontractor and Departmental Representative present.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each system specified for review by Departmental Representative including product test reports indicating compliance with specified acoustical performance requirements and meeting fire resistance requirements listed in this Section.

- .2 Samples: Submit two (2) sets of samples to Departmental Representative for verification of materials supplied to the project in sets for each colour, texture, and pattern specified, showing full range of expected variations expected as follows:
 - .1 200 mm x 275 mm samples of each acoustic panel type, pattern, and colour.
 - .2 Set of 300 mm long samples of exposed suspension system members, including mouldings, for each colour and system type required.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Coordination Drawings: Submit coordination drawings including reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:
 - .1 Ceiling suspension system members
 - .2 Method of attaching suspension system hangers to building structure
 - .3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction
 - .4 Minimum Drawing Scale: 1 to 50
 - .2 Source Quality Control Testing: Submit fastener test results indicating that fasteners and anchors used to suspend the ceiling system have a minimum capacity of 890 N in tension and that anchors used to attach bracing wires have a minimum capacity of 1960 N in tension.
 - .3 Certificates: Submit written certification after completion of project for each product specified indicating compliance with acoustical and fire performance requirements signed by the panel manufacturer, and that materials supplied as components meet or exceed the specified requirements.

1.4 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Section 01 78 23 – Operations and Maintenance Data:
 - .1 Submit specific maintenance practices indicating any materials that may damage or disfigure the finished Work.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide acoustical wood ceilings meeting flame spread and smoke developed requirements in accordance with ULC S102.
 - .2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Installers: Use installers having proven experience in completing acoustical wood ceilings having similar material, design, and complexity as that required for this project and having a record of successful in-service performance for the previous two (2) years.
-

- .2 Manufacturers: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver acoustical wood ceiling components to site in original, unopened packages and store in fully enclosed space, protected against damage from moisture, direct sunlight, surface contamination, and other causes, and when temperature and humidity of installation and storage areas approximate conditions that will exist when building is occupied.
- .2 Storage and Handling Requirements: Allow acoustic wood ceiling components to reach room temperature and stabilized moisture content before installing; handle acoustic wood ceiling components to avoid chipping edges or damaging units in any way; replace damaged units when directed by Departmental Representative.

1.7 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where acoustical wood ceilings are indicated to fit between walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating acoustical wood ceilings without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.
- .3 Environmental Requirements: Perform installation when heating and cooling systems are operational, and temperature and humidity closely approximate the interior operating conditions required for the final construction; allow wood materials to acclimate and stabilize to site conditions a minimum of 72 hours before installation when site is free of wet and dusty work, and above ceiling work is complete.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Superimposed Loads: Determine superimposed loads applied to suspension systems by components of the building and verify that adequate hangers are installed to support additional loads in conjunction with normal loads of the ceiling system, and as follows:
 - .1 Maximum Deflection: Limit deflection to L/360 in accordance with ASTM C635/C635M deflection test.
 - .2 Manufacture and install components to provide minimum Noise Reduction Coefficient (NRC) listed for specified products; test in accordance with ASTM C423.
 - .3 Limit flame spread rating of materials supplied to the project and that are used in exits to 25 or less, with smoke developed at 450 or less when tested in accordance with CAN/ULC S102.
-

2.2 MATERIALS

- .1 Acoustical Wood Ceiling Panel (C6):
 - .1 Veneer: Face veneer, nominal 0.6 mm thickness, Walnut, finished with two (2) coats of ultraviolet light cured polyacrylate, balancing veneer to manufacturer's standard.
 - .2 Support System: Manufacturer's standard tongue and groove connection and suspension clip spaced at maximum 610 mm o/c.
 - .3 Acoustical Performance:
 - .1 Insulation: Manufacturer's standard 50 mm thick fibreglass acoustic insulation.
 - .2 Noise Reduction Coefficient: Minimum 0.50 in accordance with ASTM C423.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine substrates and structural framing for compliance with requirements specified in this and other Sections that affect ceiling installation, anchorage, and other conditions affecting performance of acoustical wood ceilings.
- .2 Installation of ceiling system indicates acceptance of conditions.

3.2 PREPARATION

- .1 Measure each ceiling area and establish layout of wood panels to balance border widths at opposite edges of each ceiling:
 - .1 Install acoustical wood ceilings in accordance with layout indicated on reflected ceiling plans.
 - .2 Avoid using panels less than ½ width at borders.

3.3 INSTALLATION

- .1 Install acoustical wood ceilings in accordance with manufacturers written instructions and as follows:
 - .1 Install ceiling suspension system in accordance with ASTM C636.
 - .2 Install ceiling suspension systems requiring seismic restraint in accordance with ASTM E580/E580M.
 - .2 Suspend ceiling hangers from building's structural members, and as follows:
 - .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - .2 Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other means that prevents creating kinks in the suspension wires.
-

- .3 Install supplemental suspension members and hangers, trapezes or similar devices where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support manufacturer's suspension system; size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - .4 Secure wire hangers to ceiling suspension members and to supports above using a minimum of three tight turns.
 - .5 Connect hangers directly to structure or to flat, angle, channel or rods securely fastened to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are:
 - .1 Secure.
 - .2 Appropriate for substrate.
 - .3 Will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - .6 Attach hangers to structural members or intermediate supports:
 - .1 Do not support ceilings directly from permanent metal forms or floor deck.
 - .2 Do not attach hangers to steel deck tabs.
 - .3 Do not attach hangers to steel roof deck.
 - .7 Space hangers at 1220 mm maximum along each member supported directly from hangers, and provide hangers not more than 200 mm from ends of each member.
 - .8 Provide additional hangers where there are lay-in electrical or mechanical fixtures, one at each corner and; if required, stabilizer bars to prevent overloading or rotation of suspension members.
 - .9 Level ceilings by adjusting length of suspension wires; do not level ceilings by putting kinks in the suspension wires.
 - .10 Install Acoustic Blanket on wood panels.
 - .3 Install edge mouldings and trim of type indicated at perimeter of acoustic ceiling area and where necessary to conceal edges of wood panels, and as follows:
 - .1 Mitre corners accurately and connect securely.
 - .2 Do not use exposed fasteners, including pop rivets, on mouldings and trim, unless specifically allowed by the Departmental Representative.
 - .4 Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - .5 Accurately fit and install wood panels into suspension system runners and edge mouldings:
 - .1 Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - .2 Damaged panels will not be acceptable, and shall be replaced.
-

3.4 CLEANING

- .1 Clean exposed surfaces of suspended unit ceilings, including trim, edge mouldings, and suspension system members.
- .2 Comply with manufacturer's written instructions for cleaning and touch-up of minor finish damage.
- .3 Remove and replace ceiling components that cannot be successfully cleaned and repaired.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for design, supply and installation ceilings consisting of acoustic panels with exposed suspension.

1.2 DEFINITIONS

- .1 AC: Articulation Classification, measured in decibels (dB); indication of sound reflected from ceiling materials to adjacent areas in open plan areas; measured in accordance with ASTM E1111.
- .2 CAC: Ceiling Attenuation Class, measured in decibels (dB); indication of amount of sound passing through a panel and plenum to adjacent spaces; measured in accordance with ASTM E1414.
- .3 NRC: Noise Reduction Coefficient, measure of the absorption of sound energy, measured in sabins; indication of amount of noise a panel will absorb in open plan areas measured in accordance with ASTM C423.
- .4 LR: Light Reflectance, measured as percentage of the amount of light returned from the surface of materials compared to the source.

1.3 REFERENCE STANDARDS

- .1 Acoustic Materials Association (AMA):
 - .1 AMA-1-11, Ceiling Sound Transmission Test by the Two-Room Method.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A580/A580M-12, Standard Specification for Stainless Steel Wire
 - .2 ASTM A635/A635M-09, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, 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
 - .4 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - .5 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .6 ASTM C635/C635M-12, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - .7 ASTM C636/C636M-08, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustic Tile and Lay-In Panels
 - .8 ASTM E84-12c, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .9 ASTM E1111-07, Standard Test Method for Measuring the Interzone Attenuation of Ceiling Systems

- .10 ASTM E1264-08e1, Standard Classification for Acoustic Ceiling Products
- .11 ASTM E1414-06, Standard Test Method for Airborne Sound Attenuation between Rooms Sharing a Common Ceiling Plenum
- .12 ASTM E1477-98a (2008), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
- .3 Ceilings and Interior Systems Construction Association (CISCA):
 - .1 CISCA Ceiling Systems Handbook

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Conference: Conduct conference at Project site in accordance with requirements of Section 01 31 19 – Site Meetings with Contractor, ceiling Subcontractor and other parts of the Work affected by work of this Section to coordinate placement of ceiling mounted components.
- .2 Coordination: Coordinate layout and installation of acoustic panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire suppression system, and partition assemblies, and as follows:
 - .1 Schedule and coordinate installation of ceiling to occur subsequent to completion of overhead mechanical and electrical work.
 - .2 Schedule and coordinate ceiling installation with mechanical and electrical trades building in components into ceiling finish panels.
 - .3 Schedule and coordinate removal of mechanical and electrical fixtures and accessories with qualified personnel during demolition of existing acoustical panel ceilings

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of product specified.
 - .2 Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:
 - .1 Ceiling suspension system members
 - .2 Method of attaching suspension system hangers to building structure
 - .3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction
 - .4 Minimum Drawing Scale: 1 to 50
 - .3 Samples for Initial Selection: Manufacturer's colour charts consisting of actual acoustic panels or sections of acoustic panels, suspension systems, and mouldings showing the full range of colours, textures, and patterns available for each type of ceiling assembly indicated.
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- .4 Samples for Verification: Full size units of each type of ceiling assembly indicated; in sets for each colour, texture, and pattern specified, showing the full range of variations expected in these characteristics:
 - .1 150 mm square samples of each acoustic panel type, pattern, and colour
 - .2 Set of 300 mm long samples of exposed suspension system members, including mouldings, for each colour and system type required
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Product Test Reports: Provide test results performed by a qualified testing agency of each acoustic panel ceiling and metal suspension system specified for the project indicating acoustic performance for AC (if applicable), CAC and NRC, and performance requirements as follows:
 - .1 Provide written proof that acoustic panel ceiling metal suspension system have been certified by manufacturer and meets and are compliant with ASTM C635/C635M loading requirements.
 - .2 Mark all cartons of main tees with labelling certification for load compliance requirements.
 - .2 Fastener Test Results: Test data indicating that fasteners and anchors used to suspend the ceiling system have a minimum capacity of 890 N in tension and that anchors used to attach bracing wires have a minimum capacity of 1960 N in tension.

1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit copies of manufacturer's written maintenance information for inclusion in the operations manual in accordance with 01 78 00 – Closeout Submittals; provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturer: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.
 - .2 Installer: Use installer having proven experience in completing acoustic panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in service performance for the previous two (2) years.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver acoustic panels and suspension system components to Project site in original, unopened packages and store in a fully enclosed space, protected against damage from moisture, direct sunlight, surface contamination, and other causes.

- .2 Storage and Handling Requirements: Permit acoustic panels to reach room temperature and stabilized moisture content before installing; handle acoustic panels to avoid chipping edges or damaging units; replace damaged units as directed by Departmental Representative.

1.9 SITE CONDITIONS

- .1 Ambient Conditions: Install acoustic unit ceilings only when building is enclosed, has sufficient heat, when overhead mechanical and electrical work is complete, and dust and moisture producing activities are complete; maintain uniform temperatures and relative humidity within range recommended by material manufacturer from the time of installation until Substantial Performance for the project; make adjustments to temperature and humidity gradually within tolerances indicated by manufacturer.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Superimposed Loads: Determine superimposed loads applied to suspension systems by components of the building and verify that adequate hangers are installed to support additional loads in conjunction with normal loads of the ceiling system, and as follows:
 - .1 Maximum Deflection: Limit deflection to L/360 in accordance with ASTM C635/C635M deflection test.

2.2 MATERIALS

- .1 Acoustic Panels: Provide manufacturer's standard panels of configuration indicated in accordance with ASTM E1264 classifications as designated by the nominal values for types, patterns, acoustic ratings, and light reflectance class listed in this Section; with flame spread rating of 25 or less and smoke developed rating of 50 or less when tested in accordance with CAN/ULC S102 and as follows:
 - .1 Acoustic Panel Ceiling: C1
 - .1 Physical Properties: Type XII, Form: 2
 - .2 Surface Pattern: E
 - .3 Dimensions: As indicated on drawings
 - .4 Edge Profile: Tegular
 - .5 Colour: White
 - .6 Acoustic and Visual Performance (Minimum Nominal):
 - .1 NRC: 0.90
 - .2 AC: 180
 - .3 LR: 0.90
 - .2 Acoustic Panel Ceiling: C2
 - .1 Physical Properties: Type XII, Form: 2
 - .2 Surface Pattern: E
 - .3 Dimensions: As indicated on drawings
 - .4 Edge Profile: Tegular
 - .5 Colour: White

- .6 Acoustic and Visual Performance (Minimum Nominal):
 - .1 NRC: 0.90
 - .2 AC: 180
 - .3 LR: 0.90

 - .2 Metal Suspension System – Acoustical Panel Ceilings: Manufacturer's standard direct hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635/C635M requirements and as supplied by same materials supplier as acoustic panels for intermediate duty, exposed tee bar and as follows:
 - .1 Tee Bar Grid Face Width: 24 mm as appropriate for materials specified.
 - .2 Module: Sized as appropriate to acoustic panel size.
 - .3 Hangers, Braces and Ties: Nominal 2.78 mm (12 ga.) Ø steel wire, galvanized in accordance with ASTM A641.
 - .4 Exposed Finish: Manufacturer's standard satin, white finish
 - .5 Corrosion Resistance: Hot-dip galvanized or stainless steel components.
 - .6 Acceptable materials: materials to match products specified, use only materials from same manufacturers of panel products.

 - .3 Attachment Devices: Size for five (5) times design load indicated in ASTM C635/C635M, Table 1, Direct Hung, having corrosion protection for mild service conditions, and as follows:
 - .1 Concrete Anchors: Anchors of type to option of Contractor, with holes or loops for attaching hangers having capacity to sustain ceiling loads as indicated in above, selected from one of the following types:
 - .1 Cast-in-place anchors
 - .2 Post Installed expansion anchors
 - .3 Chemical anchors
 - .4 Powder actuated fasteners, except that design load is sized for ten (10) times that indicated above.
 - .2 Rod and Flat Hangers: Mild steel, zinc coated.
 - .3 Angle Hangers: Minimum 22 mm x 22 mm x 1 mm thick angles, Z275 (G90) galvanized steel sheet in accordance with ASTM A653/A653M; bolted connections using 8 mm Ø bolts.

 - .4 Profiled Edge Mouldings and Trim: Manufacturer's standard extruded aluminum or cold rolled steel edge mouldings and trims, including splice plates, corner pieces, attachments and other clips, and as follows:
 - .1 Size: nominal 152 mm high
 - .2 Profile: Flat
 - .3 Exposed Finish: Manufacturer's standard satin, white finish.
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2.3 ACCESSORIES

- .1 System Accessories:
 - .1 Hold-Down Clips for Wind Uplift: Provide hold down clips spaced 610 mm O_C on all cross tees for interior ceilings consisting of acoustic panels weighing less than 4.88 kg/m².
 - .2 Impact Clips: Where indicated, provide manufacturer's standard impact clip system designed to absorb impact forces against acoustic panels.
 - .3 Sealant: Acrylic type as specified in Section 07 92 00 for use in exposed locations, colour to match ceiling grid.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that substrates and structural framing are in accordance with manufacturer's requirements specified in this and other Sections that affect ceiling installation, anchorage, and other conditions affecting performance of acoustic panel ceilings.
 - .1 Installation of ceiling system indicates denotes acceptance of site conditions.

3.2 PREPARATION

- .1 Modify existing ceiling grid and install new wall moulding to suit partition layout as indicated on drawings.
- .2 Measure each ceiling area and establish layout of acoustic panels to balance border widths at opposite edges of each ceiling:
 - .1 Install acoustic panel ceilings in accordance with layout indicated on reflected ceiling plans
 - .2 Layout acoustic panel ceilings to avoid use of panels less than half the width of full sized panels at borders

3.3 INSTALLATION

- .1 Manufacturer's Instructions: Install acoustic panel ceilings in accordance with manufacturers written instructions and as follows:
 - .1 Install ceiling suspension system in accordance with ASTM C636.
 - .2 Install ceiling suspension systems requiring seismic restraint in accordance with ASTM E580/E580M.
- .2 Acoustic Panel Suspension System: Install acoustic panel system by suspending ceiling hangers from building's structural members and as follows:
 - .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system:
 - .1 Do not support ceilings directly from permanent metal forms, floor deck or other non-structural framing.
 - .2 Do not attach hangers to steel deck tabs.

- .3 Do not attach hangers to steel roof deck.
 - .4 Attach hangers to structural members or intermediate supports.
 - .2 Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other means that does not create a kink in the suspension wires.
 - .3 Install supplemental suspension members and hangers in form of trapezes or similar devices where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support standard suspension system members:
 - .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - .4 Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns.
 - .5 Connect hangers directly to structure or to flat, angle, channel or rods securely fastened to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are:
 - .1 Secure
 - .2 Appropriate for substrate
 - .3 Will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures
 - .6 Space hangers at 1220 mm maximum along each member supported directly from hangers, and provide hangers not more than 200 mm from ends of each member.
 - .7 Provide additional hangers where lay-in electrical or mechanical fixtures are installed in suspension system; one at each corner with stabilizer bars to prevent overloading or rotation of the suspension members where required.
 - .8 Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 - .9 Do not level ceilings by putting kinks in the suspension wires.
 - .3 Trims and Edging: Install edge mouldings and trim of type indicated at perimeter of acoustic ceiling area and where necessary to conceal edges of acoustic panels:
 - .1 Fasten mouldings to substrate at 406 mm ^o/c, not more than 75 mm from ends, levelling with ceiling suspension system to a tolerance of 3 mm in 3600 mm.
 - .2 Mitre corners accurately and connect securely.
 - .3 Do not use exposed fasteners, including pop rivets, on mouldings and trim, unless specifically allowed by the Departmental Representative.
 - .4 Install profiled edge moulding and trim in accordance with manufacturer's written instructions.
 - .4 Acoustic Panels: Accurately fit and install acoustic panels into suspension system runners and edge mouldings; scribe and cut panels at borders and penetrations to provide a neat, precise fit; replace damaged panels at no expense to the Departmental Representative and as follows:
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- .1 Arrange directionally patterned acoustic panels as follows:
 - .1 As indicated on reflected ceiling plans.
- .2 Tegular Edged Panels: Install panels with bottom of reveal in firm contact with top surface of runner flanges; cut new reveal in acoustic panels to match profile of specified tegular edge; paint cut panel edges remaining exposed after installation; match colour and finish of exposed panel surfaces using coating recommended in writing for this purpose by acoustic panel manufacturer.
- .3 Install hold down clips in areas indicated, in areas required by authorities having jurisdiction, spaced as recommended by panel manufacturer's written instructions.

3.4 SITE QUALITY CONTROL

- .1 Inspection and Testing: Testing will take place in successive stages in areas described below:
 - .1 Proceed with installation of acoustic panel ceilings only after test results for previously installed hangers comply with requirements.
 - .2 Tests will be performed when installation of ceiling grid on each floor has reached 20% completion with no panels installed as follows:
 - .1 One of every two post installed anchors used to attach bracing wires to concrete and test them for 1960 N of tension.
 - .2 Testing agency will test those anchors not previously tested until 20 consecutively pass and then will resume initial testing frequency when testing discovers fasteners and anchors that do not comply with requirements.
 - .3 Testing agency will report test results promptly and in writing to Contractor and Departmental Representative.
- .2 Non-Conforming Work: Remove and replace fasteners and anchors that test results indicate do not comply with specified requirements; additional testing will be performed to determine compliance with specified requirements where fasteners and anchors are removed and replaced.

3.5 CLOSEOUT ACTIVITIES

- .1 Cleaning: Clean exposed surfaces of acoustic panel ceilings, including trim, edge mouldings, and suspension system members in accordance with manufacturer's instructions.
- .2 Repairs: Touch-up minor damage to finishes in accordance with manufacturer's instructions; remove and replace ceiling components that cannot be successfully cleaned and repaired.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM F1066-04(2010)e1, Standard Specification for Vinyl Composition Floor Tile.
 - .2 ASTM F1344-10, Standard Specification for Rubber Floor Tile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
 - .2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data in accordance with Section 01 33 00.
- .3 Provide samples in accordance with Section 01 33 00.
 - .1 Submit duplicate tile in size specified, 300 mm long base, and transitions strips as applicable.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and for 48 hours after installation.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials of resilient tile flooring, base and adhesive in accordance with Section 01 78 00.
 - .2 Provide 5% of each colour, pattern and type flooring material required for this project for maintenance use.
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- .3 Extra materials from same production run as installed materials.
- .4 Identify each container of floor tile and each container of adhesive.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.
- .6 Store where directed by Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Vinyl composition tile: to ASTM F1066, Composition 1 - non asbestos Class 1 - solid colour and Class 2 - through pattern tile as indicated in finish legends, 2 mm, 300 x 300 mm size, in colour indicated.
- .2 Finish: Factory prefinished.
- .3 Resilient base: vinyl, coved, minimum 1200 mm length and height as indicated on Finish legend x 3 mm thick, including premoulded end stops and external corners for coved base only, of colour indicated.
- .4 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .5 cementitious paste as recommended by flooring manufacturer for use with their product.
- .6 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .7 Sealer: to CAN/CGSB-25.20, Type 2-water based.
- .8 Wax: type recommended by flooring manufacturer.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSPECTION

- .1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

3.3 SUB-FLOOR TREATMENT

- .1 Remove existing resilient flooring.
 - .2 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.
 - .3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
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- .4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .5 Prime concrete to flooring manufacturer's printed instructions.

3.4 TILE APPLICATION

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .4 Install flooring to square grid pattern with joints aligned with pattern grain parallel for units and parallel to length of room.
- .5 As installation progresses, and after installation, roll flooring in 2 directions with 45 kg minimum roller to ensure full adhesion.
- .6 Cut tile and fit neatly around fixed objects.
- .7 Install feature strips and floor markings where indicated. Fit joints tightly.
- .8 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .9 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 BASE APPLICATION

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles, minimum 300 mm each leg. Wrap around toeless base at external corners.
- .8 Install toeless type base before installation of carpet on floors.

3.6 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
-

- .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .2 Remove excess adhesive from floor, base and wall surfaces without damage.
- .3 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

3.8 PROTECTION

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of tufted carpet and cushioned underlayment with all necessary trims and accessories required for a complete installation.

1.2 REFERENCE STANDARDS

- .1 American Association of Textile Chemists and Colorists (AATCC):
 - .1 AATCC 16-2004, Colour Fastness to Light
 - .2 AATCC 134-2006, Electric Propensity of Carpets
 - .3 AATCC 138-2005, Cleaning: Washing of Textile Floor Coverings
 - .4 AATCC 174-2007, Antimicrobial Activity Assessment of Carpets
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM E648-10, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 - .2 ASTM E662-12a, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Install carpeting before installing items indicated for installation on top of carpet and after other finishing operations, including painting and ceiling construction, has been completed.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's standard product data indicating requirements for installation.
 - .2 Samples: Submit samples of each type of tile carpeting and adhesive required for the project for confirmation of project requirements.
 - .3 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of manufacturer's recommended moisture content to actual moisture vapour emission rate.
 - .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Site Quality Control Test Results: Submit results or moisture emission testing of concrete subfloors prior to installation of flooring. Results shall include comparison of manufacturer's recommended moisture content to actual moisture vapour emission rate.
-

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use only carpeting materials that have been tested and accepted for labelling under ULC S102.2 and meeting requirements of the Authority Having Jurisdiction.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: Maintain temperature and ventilation in work area using permanent heating system, and portable supply and exhaust fans in accordance with manufacturer's requirements and as follows:
 - .1 Install Tile Carpeting when wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.
 - .2 Install Tile Carpeting over concrete subfloor once slabs have cured and are sufficiently dry to bond with adhesive and concrete subfloor have pH range recommended by carpet manufacturer.

1.7 WARRANTY

- .1 Joint and Several Warranty: Notwithstanding the 12 months warranty period specified in the General Conditions of Contract, the carpet manufacturer's warranty specified in this Section is extended to a period of 2 years from date of Substantial Performance and as follows:
 - .1 Warranty shall cover defects of materials or workmanship detrimental to long term appearance, retention or performance without use of chair protectors, except where caster wheeled chairs are placed directly over seams; installation will be subject to twisting and turning wear and exposure to sand and grit causing abrasion.
 - .2 Warranty shall be binding to the fibre manufacturer, carpet manufacturer and installer to share responsibility for the supply and installation of the specified materials, as follows:
 - .3 Fibre manufacturer shall provide the following minimum warranty conditions:
 - .4 Face Fibre Wear: Fibre loss beyond 10% from abrasive wear: Lifetime.
 - .5 Antistatic to ≤ 3.5 kV: Lifetime of installation
 - .6 .Colour Permanence: Lifetime.
 - .7 Moisture Resistance: Lifetime of installation
 - .8 Backing Delamination: Lifetime of installation.
 - .9 Staining and Soiling Protection: Lifetime of installation
 - .10 Dimensional Stability: Lifetime of installation
 - .11 Edge Ravel: Lifetime of installation
 - .12 Flammability: Lifetime of installation
 - .1 Carpet manufacturer: Provide performance warranty agreeing to repair or replace carpet that exhibits edge ravel, zippering or delamination of backing materials, or other defects of materials detrimental to long term performance of the carpet.
 - .2 Carpet Installer: Provide the following minimum warranty coverage conditions:

- .1 Repair or replacement of carpet showing failure of seams, stretching or wrinkling, or other defects of workmanship detrimental to long term appearance for a period of two (2) years from date of Substantial Performance.
- .2 Warranty shall be in the form of a maintenance Bond made out in the Owner's name.

Part 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- .1 Modular tile carpeting performance requirements are based on acceptable minimums published by the Carpet and Rug Institute as follows, and as otherwise modified by actual materials specified:
 - .1 Dimensional Stability: $\pm 0.10\%$ Maximum
 - .2 Colourfastness: Test all specified colours; provide proof of performance before installation of specified materials:
 - .1 Lightfastness AATCC 16: $\geq 4.0 @ 60$ AFU
 - .3 Antimicrobial: In accordance with AATCC 138 Washed, and AATCC 174 Parts 2&3.
 - .4 Electrostatic Propensity AATCC 134: Permanent static control using static conducting fibres or durable static control for lifetime of carpet where static conducting fibres do not form a part of the manufacturer's standard construction providing ≤ 3.0 kV dissipation.
 - .5 Flammability: Tested in accordance with ASTM E648 and ASTM E662, and as follows:
 - .1 Radiant Panel Test: Class 1
 - .2 Smoke Density: ≤ 450

2.2 MATERIALS

- .1 Face Construction: Tufted
- .2 Pile Surface Appearance:
 - .1 Level loop: Textured
- .3 Pile fibre: to CAN/CGSB-4.129:
 - .1 Nylon: type 6 Nylon
- .4 Dye Method: solution Dye

2.3 ACCESSORIES

- .1 Adhesive and Seam Cement: Self release type, recommended by tile carpeting manufacturer; low odour based, low VOC.
- .2 Trowellable Levelling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the Tile Carpeting manufacturer.

- .3 Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- .4 Resilient Accessories: Transition strips, and rubber base as specified in Section 09 65 00, of types indicated on drawings and as required to protect exposed edge of carpet; maximum lengths to minimize running joints.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.
- .2 Verification of Conditions (Concrete Substrates): Verify that concrete substrates and conditions are satisfactory for carpet installation and comply with the following specified requirements:
 - .1 Concrete subfloor complies with ASTM F710 and moisture emissions are within manufacturer's recommendations in accordance with ASTM F1869.
 - .2 Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
 - .3 Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet cushion manufacturer.
 - .4 Slabs are free of cracks, ridges, depressions, scale, and foreign deposits that could affect the quality of the carpet installation.
- .3 Preinstallation Testing: Provide three (3) working days notice to the Departmental Representative before commencement of the Work; include cost of testing as a part of the price for work of this Section and as follows:
 - .1 Do not install flooring over concrete subfloor until slabs have cured and are sufficiently dry to bond with adhesive, as determined by carpet manufacturer's recommended bond and moisture test, and as follows:
 - .1 Carpet manufacturers generally set an acceptable safe moisture emission level of concrete subfloor at 1.5 kg/100 m² per 24 hours; confirm manufacturer's recommended emission rate before starting testing.
 - .2 Moisture tests must be conducted on all concrete subfloor and is especially critical where low VOC or water based adhesives are specified.
 - .3 Test moisture emission rate of concrete subfloor before installing flooring, using the calcium chloride test method in accordance with ASTM F1869.
 - .4 Carefully monitor test conditions to ensure that tampering or disturbance of the test packs does not affect the results.
 - .5 Maintain a minimum temperature of 18°C for substrates during testing operations.

- .6 Test pH level of slab and correct surfaces having an alkali content of pH 9 or higher.
- .4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Subfloor Treatment: Remove dust, dirt, sealer and wax from existing surfaces; remove ridges and bumps; seal porous and powdery surfaces with concrete floor sealer and apply sub-floor filler to low spots and cracks to achieve level floor to a tolerance of 1:500 in accordance with manufacturer's written requirements.
- .2 Test Layout: Dry lay 10 m² area of tile carpeting with required seam and nap direction and obtain acceptance from Departmental Representative before commencing with installation.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's printed instructions using material from same dye lot; mix materials to obtain consistent colour, pattern and texture match within any one visual area.
- .2 Layout tile carpeting in quarter turn, pattern as indicated on drawings.
- .3 Fit neatly around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses and around projections:
 - .1 Cut tile carpeting to fit accurately around perimeter of rooms into all recesses and around fixtures.
 - .2 Make cut outs for floor mounted service boxes, receptacles, switches, hardware where they occur on tile carpeting.
 - .3 Cut holes as close as possible to allow services to pass through and that trim will completely hide hole when installed.
 - .4 Cooperate and coordinate with electrical trade to ensure correct location of outlets is obtained.
- .4 Install edging strips at all openings or doorways and where tile carpeting abuts other floor covering.

3.4 CLOSEOUT ACTIVITIES

- .1 Clean-Up: Remove tile carpeting waste and debris from premises and leave installation clean after completion of carpeting operations in an area; protect finished areas from work following installation in accordance with manufacturer's written instructions.
- .2 Repairs: Replace damaged or defective tile carpeting at no cost to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of access flooring system consisting of a series of modular, removable, interchangeable panels on an elevated support system forming an accessible under floor cavity bolted on stringer under structure.

1.2 REFERENCE STANDARDS

- .1 Architectural Aluminum Manufacturers Association (AAMA):
 - .1 High Performance Organic Coatings on Aluminum Extrusions and Panels
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM F150-06, Electrical Resistance of Conductive and Static Resilient Flooring
- .3 National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 AMP 500 Series, Metal Finishes Manual
- .4 Ceilings and Interior Systems Construction Association (CISCA):
 - .1 Recommended Test Procedures for Access Floors, 2007 Edition
- .5 National Fire Protection Association (NFPA):
 - .1 NFPA 75-2008, Standard for the Protection of Information Technology Equipment
- .6 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .2 CAN/ULC S102.2-10, Standard Method of Test for Surface Burning Characteristics of Flooring
 - .3 CAN/ULC S135-04, Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with adjacent work and verify that concrete floors are acceptable for installation of specified materials.
- .2 Pre-Construction Meetings: Conduct pre-construction meeting to verify project requirements and any unique conditions affecting installation, manufacturer's installation instructions and manufacturer's warranty requirements attended by Contractor, Subcontractor's affected by work of this Section, access flooring manufacturer's representative and Departmental Representative in accordance with Section 01 31 19.

- .3 Scheduling: Order materials and provide site verified dimensions for preparation of shop drawings in sufficient time to allow for manufacturer's fabrication lead time and project installation requirements.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
- .1 Product Data: Submit manufacturer's printed product literature and installation instructions, specifications and data sheet indicating specific materials used for work of this Section.
- .2 Shop Drawings: Submit measured shop drawings indicating layout of the work using verified site dimensional relationships to adjoining work and installation tolerances; sizes and details of components; anchorage methods; edge and fascia details; elevations differences and; floor finishes ; and location of connection to building grounding electrode.
- .3 Samples:
- .1 Access Floor System:
- .1 Submit one full size sample consisting of 4 panels of complete access flooring system including specified finishes.
- .2 Sample can be incorporated into finished installation when accepted by Departmental Representative.
- .4 Components: Submit one of each of following components for review and acceptance by the Departmental Representative:
- .1 Quarter size floor panel.
- .2 Pedestal.
- .3 Stringer member
- .4 Resilient flooring
- .5 Resilient accessories and trims; minimum 300 mm long.
- .6 Exposed metal accessories; minimum 300 mm long.
- .7 Fasteners.
- .8 Accessories.
- .5 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
- .1 Certificates: Submit product certificates signed by manufacturer certifying that materials supplied for the project comply with specified performance characteristics, design criteria and physical requirements.
- .2 Source Quality Control Submittals: Submit test reports; certified by an independent testing laboratory having a minimum of five years experience testing access floor components in accordance CISCA Recommended Test Procedures, certifying that component parts perform as specified by the manufacturer.
- .3 Structural Site Quality Control Submittals: Submit manufacturer's site review report within time period listed in Site Quality Control requirements below.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide access flooring meeting the requirements of NFPA 75 and combustibility requirements of Authority Having Jurisdiction; provide only ULC or CSA listed electric and mechanical devices.
- .2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturer: Obtain access flooring from a single source and from a single manufacturer, with panels clearly and permanently marked on underside with panel type and concentrated load rating, tested in accordance with CISCA standards for access flooring.
 - .2 Zinc Whiskers Protection: Provide steel components coated with electrostatic, baked on corrosion resistant coatings; galvanized coatings will not be acceptable.
 - .3 Installer: Use manufacturer approved installer having experience with similar installations and complexity.
 - .4 Design: Provide access floor system designed to support loads and configurations indicated; consisting of modular and removable panels supported by an adjustable height under structure support system; with individual panels capable of being removed by one person using manufacturer's standard lifting device; including all required accessories, quantities and finished floor height necessary for a complete and functional installation.
- .3 Certifications: Provide proof of the following during the course of the Work:
 - .1 Compliance Certification: Third party quality auditor is required to provide certificates indicating tested performance requirements stated in this Section were attained by the installed assemblies:
 - .2 Installation of access flooring system must be coordinated with the ongoing testing requirements of the third party quality auditor.
 - .3 Inspections and testing will be conducted as work progresses; work of this Section is responsible for notifying the Contractor so that the third party quality auditor and Departmental Representative are present during installation.

1.6 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where access flooring system is indicated to fit between or around walls, columns and other construction contiguous with access flooring; coordinate fabrication schedule with construction progress to avoid delaying the Work; indicate site measurements on shop drawings.
- .2 Ambient Conditions: Install access flooring system after spaces are fully enclosed, and area of installation is operating under permanent building ambient temperature and humidity.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Structural Performance for Panels: Provide access flooring panels capable of withstanding the following loads and stresses within limits and under conditions indicated, as determined by testing manufacturer's current standard products in accordance with referenced procedures in CISCA Recommended Test Procedures for Access Floors:
 - .1 Design Load Performance: Provide access flooring systems supported on actual under structure system components capable of withstanding a minimum design load of 450 kg; signifying that panels will support a concentrated load placed on a 6.5 cm² area at any location in the panel without yielding and having a safety factor of 2 without failing; failure is defined as the point at which access flooring system will not take any additional load.
 - .2 Uniform Load Performance: Provide access flooring systems supported on actual under structure system components capable of supporting a nominal uniform load of 16.75 kN/m²
 - .3 Rolling Load Performance: Provide access flooring systems capable of withstanding rolling loads of the following magnitude applied to non-perforated panels, with a combination of local and overall deformation not to exceed nominal 1.0 mm after exposure to rolling load over CISCA Path A or B, whichever path produces the greatest top surface deformation, and as follows:
 - .1 Wheel 1 Rolling Load: Nominal 360 kg for 10 Passes using 75 mm diameter x 46 mm wide wheel.
 - .2 Wheel 2 Rolling Load: Nominal 270 kg for 10,000 Passes using 150 mm diameter x 50 mm wide wheel.
 - .4 Impact Load Performance: Provide access flooring systems capable of withstanding an impact load of 68 kg dropped from a height of 915 mm onto a 6.5 cm² area using a round or square indenter to any location on the panel.
 - .5 Panel Drop Test: Provide panel capable of being dropped face up onto to a concrete slab from a height of 915 mm that continues to meet all load performance requirements as previously defined after completion of test.
 - .6 Panel Cut Out: Provide panel having 200 mm diameter cut out capable of withstanding ultimate load of 680 kg without failure applied anywhere on panel.
 - .7 Flammability of Finishes: Provide access flooring system having a flame spread rating of 5; fuel contribution of 10 and smoke development of 15 when tested in accordance with CAN/ULC S102 and S102.2.
 - .8 Combustibility of Support Components and Panels: Provide access floor panels qualifying as non-combustible when tested in accordance with CAN/ULC S135.
- .2 Structural Performance for Pedestal Assemblies: Provide pedestal assemblies capable of withstanding the following loads and stresses within design limits and conditions indicated in accordance with CISCA testing criteria:
 - .1 Pedestal Axial Load Performance: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding a 22. kN axial load per pedestal.

- .2 Pedestal Overturning Moment Performance: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding an overturning moment of 113 Nm per pedestal applied horizontally at top of pedestal when secured to subfloor.
- .3 Provide a means of levelling and locking the assembly at a selected height and that requires deliberate action to change height setting and prevents displacement as a result of vibration.
- .4 Ultimate Load Carrying Capacity: Not less than twice design strength.
- .3 Stringers: Provide stringer components capable of withstanding the following loads and stresses within design limits and conditions indicated:
 - .1 Stringer Concentrated Load Performance: Provide stringers, without panels in place, capable of withstanding a concentrated load of 890 N at center of span with a permanent set not to exceed 0.25 mm in accordance with CISCA testing criteria.
 - .2 Stability: Assembly to remain completely braced and rigid after a maximum of eight abutting panels are removed.
- .4 Grounding: Provide direct positive contact to components for safe continuous electrical grounding of entire access flooring system to achieve a maximum panel to under structure resistance of not more than 10 ohms.
- .5 Static Electricity Control: Provide resistance range for flooring materials from a minimum of 0.5 mega ohms to a maximum of 20,000 mega ohms, with maximum electrical resistance measured from top of panel to grounded subfloor; exposed metal will not be allowed at the wearing surface of the floor.
- .6 Earthquake Load Performance: Provide access flooring capable of withstanding a lateral seismic force (Fp) in seismic zone applicable to this Project, in accordance with requirements provincial Building Code and Authority Having Jurisdiction.

2.2 SYSTEM DESCRIPTION

- .1 Panels: Provide panels that are fully interchangeable except those altered to meet special installation conditions, and as follows:
 - .1 Panel Type: Corrosion protected steel panel with light weight cementitious core.
 - .2 Module Size: 610 mm x 610 mm.
 - .3 Top of Panel Finish: Vinyl composite tile as specified in Section 09 65 19.
 - .4 Underside and Edge Panel Finish: Baked on, static deposited, corrosion resistant epoxy finish, colour selected from manufacturer's standard range.
 - .2 Pedestals: Manufactured from corrosion resistant steel, all welded construction with adjustable height range to suit finished floor height and pedestal base adhesive or mechanical fastener, forming a part of manufacturer's standard access flooring system.
 - .3 Stringers: Manufactured from corrosion resistant steel, mechanically fastened to pedestal to provide positive electrical contact; connection based on gravity or spring action are not acceptable, and forming a part of the manufacturer's standard access flooring system.
-

- .4 Accessories: Provide premanufactured components meeting manufacturer's system requirements in configurations and locations as indicated on Drawings and as follows:
 - .1 Power, Voice and Data Service Modules: high capacity receptacle boxes with knockouts, duplex receptacles, voice and data interface plates, having grommets and hinged lid to suit floor finish requirements.
 - .2 Cable Tray: Premanufactured drop in cable tray forming a part of access flooring manufacturer's standard system.
 - .3 Vertical Closures (Fascia): Provide manufacturer's standard metal closure plates with factory applied finish where under floor cavity is not enclosed by abutting walls or other construction.
 - .4 Perimeter Support: Provide manufacturer's standard method for supporting panel edge and form transition between access flooring and adjoining floor covering at same level as access flooring.

2.3 FINISHES

- .1 Apply finishes in factory after products are fabricated.
- .2 Protect finishes on exposed surfaces with protective covering before shipment.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that concrete sealers (if used) are compatible with pedestal adhesives before starting installation of access flooring systems.
- .2 Verify that subfloor is dry and free of any surface irregularities that could reasonably be anticipated to adversely affect access flooring system appearance or performance before starting installation of access flooring systems.

3.2 INSTALLATION

- .1 Install components in accordance with access flooring system manufacturer's written instructions including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Pedestals and Stringers:
 - .1 Arrange pedestal assemblies to meet grid spacing required.
 - .2 Secure base plate to concrete floor with mechanical fasteners after adhesive has cured.
 - .3 Install additional pedestal assemblies where grid pattern is disturbed by columns, walls, ramps, openings, and steps, and at cut outs that impair floor load capacity.
 - .4 Install stringers rigidly brace floor pedestals four ways.
- .3 Floor Panels:
 - .1 Install floor panels solidly on pedestals, level to maximum variation over entire floor of 1:2000.
 - .2 Seal site cuts with plastic angles or channels; exposed cut edges will not be permitted.

- .4 Fascia Panels:
 - .1 Install fascia panels at exposed sides and where indicated.
 - .2 Secure panels to continuous angles mechanically secured to structural floor and to edge of floor panels.
 - .3 Install metal trim at intersection of fascia panels and access floor and at abutting walls and columns.
- .5 Provide electrical grounding connectors and arrange for connection by Division 26.
- .6 Adjust floor panel system for smooth, quiet operation.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services:
 - .1 Manufacturer's representative shall review work of this Section involving handling, installation, protection and cleaning, and submit written reports in acceptable format to verify compliance of work with manufacturer's written installation instructions and shop drawings.
 - .2 Provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work at following stages:
 - .1 After delivery and storage of products, and when preparatory work affecting this Section is complete, before installation begins.
 - .2 Twice during progress of work; at 25% and 60% complete.
 - .3 At completion of work; after cleaning is completed.
 - .4 Submit written reports within three (3) days of review to Departmental Representative.

3.4 CLOSEOUT ACTIVITIES

- .1 Cleaning: Perform cleaning after installation to remove construction and accumulated environmental dirt as required:
 - .1 Clean surfaces after installation using manufacturer's recommended cleaning procedures using only manufacturer recommended cleaning products.
 - .2 Remove surplus materials, rubbish, tools and equipment barriers and dispose of legally off site.
- .2 Protection: Protect access floor in accordance with manufacturer's instructions until Substantial Performance to prevent damage to finished surfaces.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
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- .4 Fire Safety Requirements:
 - .1 Supply Type ABC fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada 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 20.

1.4 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00.
 - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
 - .1 Use MPI listed materials having minimum E2 rating where indoor air quality requirements exist.
 - .2 Primer: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.

- .3 Paint: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.
- .4 Colours:
- .1 Submit proposed Colour Schedule to Departmental Representative for review.
- .2 Base colour schedule on selection of 5 base colours and 3 accent colours.
- .5 Mixing and tinting:
- .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
- .2 Use and add thinner in accordance with paint manufacturer's recommendations.
- .1 Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:
- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:
- | Gloss Level-Categor | Gloss @ 60 degrees | Sheen @ 85 degrees |
|------------------------------|--------------------|--------------------|
| Gloss Level 1 - Matte Finish | Max. 5 | Max. 10 |
| Gloss Level 2 - Velvet | Max. 10 | 10 to 35 |
| Gloss Level 3 - Eggshell | 10 to 25 | 10 to 35 |
| Gloss Level 4 - Satin | 20 to 35 | min. 35 |
| Gloss Level 5 - Semi-Gloss | 35 to 70 | |
| Gloss Level 6 - Gloss | 70 to 85 | |
| Gloss Level 7 - High Gloss | More than 85 | |
- .2 Gloss level ratings of painted surfaces to be selected by Departmental Representative.
- .7 Exterior painting:
- .1 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
- .1 EXT 5.3B - Alkyd finish.
- .8 Interior painting:
- .1 Concrete Masonry Units: smooth and split face block and brick

- .1 INT 4.2D High performance architectural latex finish
- .2 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 INT 5.1E Alkyd finish.
- .3 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 INT 5.3C - Alkyd finish (over cementitious primer).
- .4 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2E Epoxy (tile-like) finish
 - .2 INT 9.2M - Institutional low odour/low VOC finish.
- .9 Interior re-painting:
 - .1 Concrete Masonry Units: (Concrete Block and Concrete Brick).
 - .1 RIN 4.2H - High Performance Acrylic
 - .2 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 RIN 5.1E - Alkyd.
 - .3 Steel – High Heat (Boilers, Furnaces, Heat Exchangers, Breeching, Pipes, Flues, and Stacks).
 - .1 RIN 5.2B - Inorganic Zinc Rich, Maximum 400 degrees C.
 - .4 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 RIN 5.3C - Alkyd.
 - .5 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 RIN 9.2B - High Performance Acrylic finish.

Part 3 EXECUTION

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

3.2 EXAMINATION

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

- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
 - .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
 - .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
 - .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by Departmental Representative.
- .2 Use method of application approved by Departmental Representative.

- .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .7 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint fire protection piping red.
 - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
 - .6 Paint natural gas piping yellow.
 - .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
 - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Place paint and primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of manually operated bi-folding glass panel partition system with all components required for fully functioning and operable system described for the project.

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturer's Association (AAMA):
 - .1 AAMA 611-98, Voluntary Specification for Architectural Anodized Aluminum
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A666-03, Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
 - .2 ASTM B209/209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .3 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - .4 ASTM B429-06, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 - .5 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
 - .6 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .7 ASTM E557-12 (2006), Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate stacking depths with manufacturer's requirements and confirm depth of pocket provided for project installation, revise dimensions in advance of installation with affected work to ensure a proper fit, and as follows:
 - .1 Floor Flatness: Coordinate manufacturer's requirements for floor flatness and level required to obtain airtight contact between acoustic seal and floor immediately under the folding panel partition with other sections relating to concrete floor preparation and installation.
 - 1.1.1.1 Support Structure: Coordinate manufacturer's requirements for size and configuration of miscellaneous steel support beam required for attachment of track suspension system.

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
-

- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's printed product literature for folding partitions or components, and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Shop Drawings: Submit drawings indicating location and extent of partitions including; but not limited to, the following:
 - .1 Plans, elevations, sections, details, and attachments to other construction
 - .2 Head and jamb details, opening sizes, anchorage clearances, stack depths, hardware and track including floor tolerances required and direction of travel, finish pattern and colour, and accessories required for complete installation
 - .3 Dimensions, weights, conditions at openings and storage areas
 - .4 Installation requirements for storage areas and operating clearances
 - .5 Indicate blocking specifically provided and coordinated by other sections of work
 - .3 Samples for Initial Selection: Submit colour samples demonstrating full range of finishes available of specified covering for initial selection of materials required for project by Departmental Representative.
 - .4 Samples for Verification: Submit duplicate 300 x 200 mm samples of specified covering in same thickness and material indicated for the work for each folding partition cover to Departmental Representative for confirmation of selection.
- .3 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Setting Drawings: Submit setting drawings in advance of work of other sections affected by this Section indicating:
 - .1 Items embedded or cast into adjacent construction
 - .2 Cut outs and punching template in support structures and beams
 - .3 Other work required by other sections to complete their work
 - .2 Site Quality Control Submissions: Submit written report prepared by manufacturer verifying compliance with specified performance requirements of installed materials and products.
 - .3 Manufacturer's Installation Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Supplier: Obtain materials from a supplier capable of maintaining a stock of parts and components necessary to repair and maintain installed materials and products, and able to respond within a two (2) hour time period.
 - .2 Installer: Use installers that are trained and approved by manufacturer of installed materials having a minimum of five (5) years of experience in work of a similar scope and complexity as work required for Project.
-

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Package and sequence folding partition materials matching order of installation.
 - .2 Clearly mark packages with numbering system used on shop drawings; do not use permanent markings on folding partitions.

1.7 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where folding panel partitions are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating folding panel partitions without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 MATERIALS

- .1 Tempered Glass: In accordance with CAN/CGSB-12.1 and as follows:
 - .1 Thickness: 12 mm
 - .2 Type: 2 - Tempered.
 - .3 Class: B - Float Glass.
 - .4 Colour: Clear.
 - .5 Category: II - 540 J impact resistance.
 - .6 Edges:
 - .1 Exposed Edges: Flat polished.
 - .2 Butt Edges: Flat ground.
- .2 Aluminum: Materials recommended by manufacturer for type of use and finish indicated, and as follows:
 - .1 Sheet and Plate: In accordance with ASTM B209/B209M, and ANSI H35.1 AA1100-H14, or AA5005-H32 or H34, anodizing quality.
 - .2 Extruded Bars, Rods, Profiles, and Tubes: In accordance with ASTM B221, and ANSI H35.1 AA6063-T5 or T6, anodizing quality.
 - .3 Extruded Structural Pipe and Tubes: In accordance with ASTM B429, and ANSI H35.1 AA6061-T6 or AA6063-T6, anodizing quality.
 - .4 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.
 - .5 Welding Rods and Bare Electrodes: CSA W59.2.
- .3 Stainless Steel Cladding: In accordance with ASTM A 666, Type 302 or 304 as standard with manufacturer; #4 directional satin finish.

2.2 BI-FOLDING PANEL PARTITION

- .1 Description: Manually operated, top supported folding partitions as follows:
-

- .1 Partition Construction: Tempered glass panel insert as follows:
 - .1 Size: As indicated on Drawings.
 - .2 Rails: Continuous square top and bottom rail of nominal 100 mm height with stainless steel cladding.
- .2 Suspension System: Manufacturer's standard suspension track, yokes and carriers including curves, switches and multiple meeting posts as required to meet project requirements, and as follows:
 - .1 Track: Surface mounted architectural grade aluminum track designed to support weight of full glass partition.
 - .2 Trolley Yokes and Frame: Bearing mounted steel alloy trolley yoke functioning as a hinge pin at intervals supporting frame assembly.
 - .3 Carriers: Manufacturer's standard stainless steel hanging bolt and axles and nylon rollers with ball bearings.
- .3 Operating Hardware: Manufacturer's standard pull bar, draw latches, screws and installation hardware selected from manufacturer's standard finishes.
- .4 Anchors and Fastenings: Concealed.

2.3 ACCESSORY MATERIALS

- .1 Bituminous paint: Isolation coating, acid and alkali resistant asphaltic paint in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing MPI#35.
- .2 Structural sealant: Clear structural glazing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N, and ASTM C920, Type S, Grade P, Class 25, use T, M.

2.4 FABRICATION

- .1 Provide holes and cut outs in glass to receive hardware, fittings, rails, and accessories before tempering glass; do not cut, drill, or make other alterations to glass after tempering:
 - .1 Fully temper glass using horizontal process and fabricate with roll wave distortion parallel with bottom edge of door or lite when installed.
 - .2 Factory assemble components and factory install hardware to greatest extent possible.

2.5 ALUMINUM FINISHES

- .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - .2 Clear Anodized Finish:
 - .1 Class II Finish: Architectural Class II, clear coating 0.010 mm or thicker in accordance with AAMA 611.
-

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that substrate conditions and work installed by other sections match manufacturer's requirements as discussed during coordination and pre-installation meetings; starting work is denoted as acceptance of conditions.

3.2 INSTALLATION

- .1 Install folding panel partitions in accordance with requirements of ASTM E577 and in accordance with manufacturer's written instructions and as follows:
 - .1 Level tracks and fasten securely to header.
 - .2 Install partition in accordance with manufacturer's printed instructions.
 - .3 Touch up damaged finishes, repair damage to partitions to match original finish.
 - .4 Clean folding partition system and protect from damage.
 - .5 Adjust and leave partitions in smooth operating conditions.

3.3 SITE QUALITY CONTROL

- .1 Manufacturer's Site Services: Schedule site visits to comment on and provide direction to installer at following stages of construction, to ensure that work of this Section is installed in accordance with manufacturer's instructions:
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins
 - .2 Twice during progress of Work at 25% and 60% complete
 - .3 Upon completion of Work, after cleaning is carried out
- .2 Reporting: Prepare a report describing observations and any corrective measures undertaken to install folding panel partitions required to meet specified performance requirements; submit results of acoustical testing confirming specified performance requirements.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM B456-11e1, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .4 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM A924/A924M-10, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
 - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
 - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 CSA International
 - .1 CSA B651-12, Accessible Design for the Built Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
- .4 Samples:
 - .1 Samples will be returned for inclusion into work.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 304, with No.4 finish.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

- .1 Toilet tissue dispenser: Double roll type, recess mounted, chrome plated steel frame, capacity of 500 double ply roll, roll under spring tension for controlled delivery.
- .2 Combination towel dispenser/waste receptacle: recessed wall unit, approximately 355mm wide, 190 mm deep. Interior of 0.8 mm galvanized steel, exterior of 0.8 mm stainless steel. Suitable for dispensing folded or roll paper towels. Removable galvanized steel waste receptacle, lockable access door with continuous full height stainless steel hinge.
- .3 Soap dispenser: liquid push-in valve 102 mm spout, self contained 1.14 L tank, stainless steel piston and valve assembly, tamper proof filler lock, under counter recessed mounted, exposed metal components chrome plated.
- .4 Grab bars: 38 mm diameter x 1.6 mm wall tubing of stainless steel, 38 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN.

- .5 Shower curtain: 0.178 mm thick translucent vinyl shower curtain. Provide curtain hold-back hook and chain at each curtain.
- .6 Shower rods: 38 mm diameter x 2 mm wall thickness stainless steel tubing of required length with satin chrome finished flanges, 12 shower curtain hooks and curtain hold-back hook and chain. Shower rod material and anchorage to withstand downward pull of 0.9 kN.
- .7 Tilt mirror: wall mounted unit, fixed framed mirror 6 mm, stainless steel frame with integral shelf.

2.3 FABRICATION

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

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
- .2 Inform 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 from Departmental Representative.

3.2 INSTALLATION

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

- .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
- .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
- .4 Toilet and shower compartments: use male to female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer to OBC.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.
- .5 Install mirrors in accordance with Section 08 80 50.

3.3 ADJUSTING

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

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A1008/A1008M-12, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - .2 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.300-2000, Applied Coating System of Semigloss Baked Finish for Metal Office Furniture.
 - .2 CAN/CGSB-44.40-01, Steel Clothing Locker.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for metal lockers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings: type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, hooks, shelves, bases, doors, locking method and finishes.
- .4 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.
 - .2 Samples will be returned for inclusion into work.

1.3 QUALITY ASSURANCE

- .1 Installer shall be an authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- .2 Obtain metal lockers and accessories through one source from a single manufacturer. Do not modify intended aesthetic appearance of metal lockers without the Consultant's written approval; submit comprehensive explanatory data to Consultant for review where modifications are necessary to meet project requirements before submission of Bids.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal lockers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Cold Rolled Steel Sheet: Commercial Steel (CS) Type B in thicknesses indicated, suitable for exposed applications in accordance with ASTM A1008/A1008M.
- .2 Fasteners: Zinc or nickel plated steel, slotless type exposed bolt heads, and self locking nuts or lock washers for nuts on moving parts.
- .3 Anchors: Select material, type, size, and finish required for secure anchorage to each substrate, as follows:
 - .1 Provide nonferrous metal or hot dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
 - .2 Provide toothed steel expansion sleeves for drilled-in-place anchors.

2.2 MANUFACTURED UNITS

- .1 Lockers: to CAN/CGSB-44.40, Type 1-Single full-height locker, Class 1 - One complete locker, freestanding.
 - .1 Size: As indicated on Drawings, steel thickness minimum 1.519 mm, base metal thickness.
 - .2 Assembly: welded construction.
 - .3 Top: Sloped.
 - .4 Doors: one-piece double-wall envelope construction, steel minimum 1.519 mm, base metal thickness.
 - .5 Door Handle: Recessed handle stainless steel.
 - .6 Door Strike: Continuous.
 - .7 Door Style: Non-perforated panel.
 - .8 Hinges: Minimum three (3) concealed leaf fast pin type hinges, minimum 50 mm long opening 180°; fabricated from 1.897 mm base metal thickness steel securely fastened to door and frame and having non-removable pins.

- .2 Finish:
 - .1 Baked enamel or powder coat finish, colour to be selected by Departmental Representative from manufacturer's extended colour range.

2.3 ACCESSORIES

- .1 Locking system: built-in combination locks supplied by locker manufacturer with single point latching as follows:
 - .1 Non-moving latch hook designed to engage bolt of built-in combination or cylinder lock.
 - .2 Latch Hook: Equip each door with 1 latch hook, fabricated from minimum 2.657 mm thick steel; welded midway up full-height door strike; with resilient silencer.
- .2 Options: to CAN/CGSB-44.40:
 - .1 Coat Hooks: Four (4) flat 1/2" x 1/8" steel with chromium finish.
 - .2 Base: Standard steel base as supplied by manufacturer, colour to be selected by Consultant
 - .3 End Panels: Boxed steel end panels to match body panel colour to be selected by Consultant.
 - .4 Trim: Steel trim to manufacturer's standard including corner angles, jamb trim and fillers.
 - .5 Number Plates: Sequence numbered to match Owner's Standard.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive metal lockers previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to metal locker installation.
- .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 from Departmental Representative.

3.2 INSTALLATION

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
 - .2 Securely fasten lockers to grounds and nailing strips.
 - .3 Install wall trim around recessed locker banks.
 - .4 Install filler panels (false fronts) where indicated and where obstructions occur.
 - .5 Install locker numbers and locks.
-

3.3 ADJUSTING

- .1 Adjust metal lockers for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 09 68 13 – Tile Carpeting: Finish flooring in elevator cars.
- .2 Division 21 – Fire Suppression: Provision of pre-action sprinkler heads wired to shut off power to elevator equipment before activation of sprinklers.
- .3 Division 22 – Plumbing: Provision of floor drain elevator pit connected to sump and oil separator outside of elevator pit.
- .4 Division 23 – HVAC: Ventilation and temperature control of elevator equipment room.
- .5 Division 26 – Electrical:
 - .1 Electrical service to main disconnect in elevator machine room
 - .2 Electrical power for elevator installation and testing
 - .3 Electrical disconnecting device to elevator equipment prior to activation of sprinkler system
 - .4 Electrical service for machine room
 - .5 Machine room and pit receptacles with ground fault current protection
 - .6 Lighting in machine room and pit
- .6 Division 27 – Communications: Wiring for telephone service to machine room.
- .7 Division 28 – Electronic Safety and Security: Smoke detection sensors for top of elevator shaft and placement in machine room.

1.2 REFERENCE

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A276-10, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
 - .3 ASTM A480/A480M-12, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .4 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot Dip Process.
 - .5 ASTM A1008/A1008M-12, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - .6 ASTM B221-08, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .2 American Society of Mechanical Engineers (ASME)/ Canadian Standards Association (CSA):
 - .1 ASME A17.1-2007/CSA B44-07, Safety Code for Elevators and Escalators.
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- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B651-04 (R2010), Accessible Design for the Built Environment.
 - .2 CSA C22.1-09, Canadian Electrical Code Part 1, Safety Standards for Electrical Installations.
 - .3 CSA C22.2 No.45-M1981 (R2008), Rigid Metal Conduit.
 - .4 CSA C22.2 No.56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No.141-02(R2007), Unit Equipment for Emergency Lighting.
- .4 ULC - Underwriters' Laboratories of Canada
 - .1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Each shop drawing submitted shall bear stamp of qualified professional engineer registered in Canada or Province of Ontario.
- .3 Include on shop drawings:
 - .1 Pumping unit, controller, piping and other components in machine room.
 - .2 Car, guide rails, buffers and other components in hoistway.
 - .3 Rail bracket spacing and forces on guiderails.
 - .4 Outside diameter and wall thickness of cylinder, plunger and piping, and working pressure.
 - .5 Length of plunger and cylinder.
 - .6 Top and bottom clearance and overtravel of car.
 - .7 Location of circuit breaker, switchboardpanel or disconnect switch, light switch andfeeder extension points in machine room.
 - .8 Clearance between bottom of plunger and safety bulkhead of cylinder.
 - .9 Location in hoistway and machine room for connection of travelling cables for car light and telephone.
 - .10 Rating of drive motor.
 - .11 Heat dissipation of elevator equipment in machine room.
 - .12 Include on general arrangement drawings:
 - .1 Type, size, location of hoistway entrances showing method of operation, details of construction and details of fastening to hoistway structure or structural members of building.
 - .2 Car for each design specified, showing details of construction, fastening to platform, lighting, ventilation and location of car equipment.
- .4 Provide product data for:
 - .1 Operating fixtures, operating panels, signal fixtures and indicators.
 - .2 Doors and frame details.

1.4 SAMPLES

- .1 Submit duplicate 250 mm x 250 mm samples of elevator finishes in accordance with Sections 01 33 00 and 01 78 00 for:
 - .1 Cab interior.
 - .2 Cab ceiling.
 - .3 Cab door.
 - .4 Hoistway entrance doors and frames.
 - .5 Signal fixtures.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide maintenance data for elevator maintenance. Incorporate into maintenance manual specified in Section 01 78 00.
- .2 Provide parts catalogues with complete list of equipment replacement parts with equipment description and identifying numbers.
- .3 Legible schematic wiring diagrams covering electrical equipment installed, including changes made in final work, with symbols listed corresponding to identity or markings on both machine room and hoistway apparatus. Cover one copy in plastic or glass, frame and mount on wall in machine room.
- .4 Lubrication chart, plastic or glass covered, framed and mounted on wall in machine room.

1.6 ELEVATOR MAINTENANCE

- .1 Include complete maintenance of elevator equipment for a period of 12 months from the date of the Certificate of Completion.
 - .2 Regularly, systematically, monthly examine, clean adjust and lubricate equipment.
 - .3 Repair or replace electrical and mechanical parts of elevator equipment as required due to defect and normal wear and tear.
 - .4 Departmental Representative assumes responsibility for cleaning, repairs or replacements of car enclosure, hoistway enclosure, hoistway doors and door frames due to other than defect and normal wear and tear.
 - .5 Use only genuine standard parts produced by manufacturer of equipment.
 - .6 Perform work by competent personnel under supervision and in direct employ of elevator manufacturer or manufacturer's licensed agent.
 - .7 Perform work during regular trade working hours to approved schedule.
 - .8 Maintain locally adequate stock of parts for replacement or emergency purposes and provide qualified mechanics to ensure fulfillment of this service without undue loss of time in reaching job site.
 - .9 Include call-back service due to elevator stoppage or malfunction at all times at no additional cost.
 - .10 Dress maintenance personnel in uniforms. Register with designated building personnel at time of inspections.
-

1.7 WARRANTY

- .1 For the work of this Section the 12 month warranty period is extent to 3 years from date of Certificate of Completion:
 - .1 Blistering, spalling or peeling of paint due to improper surface preparation or material application.
 - .2 Opening of joints due to improper design or use of ineffective fastening devices.
 - .3 Separation, cracking or splitting of plastic laminate due to improper application to core material, or to method of fabrication which gives rise to areas of high stress concentration or which restricts normal expansion or contraction of plastic laminate.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design and construct elevator in accordance with CAN/CSA including Update #1 and all adopted supplements or revisions at time of bid, local codes and regulations.

2.2 ELEVATOR CHARACTERISTICS

- .1 Characteristics of EL1 as follows:
 - .1 Type: One (1) Holeless Hydraulic, twin hydraulic cylinder without well hole.
 - .2 Rated net capacity: 1365 kg.
 - .3 Rated speed: 0.50 m/sec n up and down direction with rated load and with maximum speed variation $\pm 5\%$ no load to rated load..
 - .4 Travel Distance (nominal): approx. 4000 mm.
 - .5 Number of Stops: 2.
 - .6 Number of Openings: 2 front.
 - .7 Inside car dimensions: 2032 mm wide x 1406 mm front to back.
 - .8 Cab Height: 2438 mm.
 - .9 Ceiling Height: minimum 2286 mm clear.
 - .10 Hoistway door opening sizes: 1067 mm wide x 2134 mm high.
 - .11 Door Type: Single slide.
 - .12 Door Operation: Side opening, single speed.

2.3 ELEVATOR CONTROL OPERATION

- .1 Two-Stop Automatic Operation: Include two-stop automatic elevator operation, as follows:
 - .1 Provide travelling cables and termination point on Car Operating Panel for card reader in accordance with Section 28 13 00. Car must remain inoperable until initiation of service by valid security card.
 - .2 Provide flush mounted operating device in car with stainless steel faceplate containing pushbuttons marked to correspond with two landings served, emergency stop switch, light switch arranged for restricted operation, door open button and alarm button.

- .3 Provide single pushbutton with stainless steel faceplate at each landing.
- .4 Arrange operation so that momentary pressure of car button for opposite terminal dispatches car to that terminal.
- .5 Allow call registered by momentary pressure of landing buttons at any time to remain registered until car stops in response to that call at that landing.
- .6 If car gate or hoistway door is not opened with short interval after car has stopped at terminal, arrange car to respond to call from other terminal.
- .2 Car Stall Protective Circuit: Automatically return car to bottom landing and open power operated doors if cars should stall as result of relay failure, valve failure or low oil in system while ascending. Restore service by opening and reclosing main line switch.
- .3 Two-Way Leveling:
 - .1 Include automatic two-way leveling device. Approach landing stops at reduced speed from either direction of travel.
 - .2 Level with accuracy of 10 mm under varying load conditions.
 - .3 Maintain car floor within 10 mm level with landing floor with two-way automatic maintaining leveling device.
- .4 Emergency Operation: Include means to automatically return the elevator to the lowest landing upon failure of normal power supply. Include door operation.

2.4 ELEVATOR TYPE

- .1 Use direct acting plunger, pumping unit, storage tank and magnetic control valves.
- .2 Locate pump unit and associated control equipment in machine room shown on drawings.
- .3 Deliver operating fluid directly into cylinder at necessary pressure and in sufficient quantity to lift rated load at rated speed.
- .4 Use glycol or ester based fluids or similar fluids specially formulated for high fire resistance and low smoke production, as operating fluid. Ensure seals, packing and plastic materials used are unaffected by fluid used.

2.5 PERFORMANCE REQUIREMENTS

- .1 Design and adjust equipment to provide smooth acceleration and deceleration of car without perceptible steps so adjusted as not to cause passenger discomfort.
- .2 Minimum time for doors to remain fully open shall be no less than 3 seconds upon car call.
- .3 Use by Handicapped:
 - .1 Comply with NBC 2010, CSA B651, and as follows:
 - .1 Locate upper most button in elevator cab control panel and centre-line of telephone instrument not more than 1370 mm above floor level.
 - .2 Provide 63 mm high x 6 mm thick stainless steel flat handrail on three sides of car with ends returned close to panels and removable from inside car. Provide a minimum clearance between rail and wall of 40 mm at a nominal height of 920 mm to top of handrail from the floor.

- .3 Provide 63 mm high x 6 mm thick stainless steel flat bumper rail on three sides of car with ends returned close to panels and removable from inside car. Provide a minimum clearance between rail and wall of 40 mm at a nominal height of 300 mm to top of handrail from the floor.
- .2 Provide Arabic numerals 16 mm in height raised 0.8 mm immediately to left of floor buttons.

2.6 WELDING

- .1 Where welding is used for cylinder and pressure piping, prepare joints and weld in approved manner using welders fully qualified for pressure vessel welding.
- .2 Where directed, subject welds to radiographic or other non-destructive inspection.
- .3 Identify field welds with welder's identification stamp.

2.7 MATERIALS AND COMPONENTS

- .1 Use major elevator components from standard product line of one manufacturer unless otherwise approved by Departmental Representative.
- .2 Use components only which have performed satisfactorily together under conditions of normal use in not less than two other elevator installations of similar design and for a period of at least one year. Furnish names and addresses of Engineers or managers of buildings, in which proposed combination of major components has so performed.
- .3 Steel sheet metal: to ASTM A1008/A1008M. Cold-rolled sheet, commercial quality; to ASTM A653/A653M, minimum 25% recycled content.
- .4 Stainless steel sheet metal: to ASTM A167, Type 304 with satin finish, minimum 25% recycled content.
- .5 Stainless steel bars, wire and shapes: to ASTM A276, Type 304 with satin finish.
- .6 Provide fastenings concealed from public view designed to withstand normal use.

2.8 POWER SUPPLY

- .1 Equipment Power: 575 V, 50 Amp, 3 phase, #6 wire, 60 Hz, alternating current.
- .2 Lighting: 120 V, 15 Amp, single phase, #12 wire, 60 Hz, alternating current.

2.9 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45, galvanized steel or hot dipped galvanized steel threaded.
- .2 Flexible metal conduit: to CSA C22.2 No.56, liquid-tight flexible metal.

2.10 CONDUIT FITTINGS AND BONDING

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
 - .1 Use steel compression type fittings where electrical metallic tubing is used. Fittings with set screws are not acceptable unless a separate identified grounding conductor is also installed inside raceway.
- .2 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.11 ELECTRICAL COMPONENTS

- .1 Include minimum 10% spare conductors and two pairs of shielded audio cables in travelling cable.
- .2 Travelling cable will terminate in machine room and at underside of car platform, there will be no halfway box. Travelling cable to meet CSA designation "EO" to maintain flexibility in extreme weather conditions.
- .3 Provide a separate insulated bonding wire in every conduit or raceway and bond all metal enclosures to ground. (as per CEC 2012) Do not use armoured flexible metal conduit as grounding conductor.
- .4 Do not parallel conductors to increase current carrying capacity unless individually fused.
- .5 Provide additional wiring as required, to suit machine room layout.

2.12 SOUND ISOLATION

- .1 Provide sound isolation between plunger plate and car frame.
- .2 Provide sound isolation between pumping unit and controller, motor and pump.
- .3 Prevent lateral displacement of pumping unit.

2.13 LUBRICATION

- .1 Include means of lubricating bearings requiring periodic lubrications.
- .2 When used, provide grease fittings which fit same gun.
- .3 Where grease cups are provided, use automatic feed compression type.
- .4 Provide visible and easily accessible lubrication points.

2.14 ROLLER GUIDES

- .1 Equip car with roller guides mounted on top and bottom of car frame.
- .2 Provide each guide with, durable oil resistant resilient tired ball bearing rollers running on three finished rail surfaces.
- .3 Do not lubricate guide rails. Maintain each roller on its respective guide in uniform contact with rail surface at all times by means of substantial springs or by resilient mountings.
- .4 Provide guide operation which is inaudible to passengers in car or outside hoistway with car operating at rated speed and car fan turned off.
- .5 Use tire material which will not develop flatspots after standing idle for 24 h under average environmental conditions.
- .6 Balance car.

2.15 GUIDE SHOES

- .1 Use swivel type guide shoes for car. Assemble on metal base to permit self-alignment.
 - .2 Equip each shoe with renewable, non-metallic wearing gibs or inserts and spring take up for side play between guide rails.
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- .3 Include renewable wearing gibs made of durable non-metallic material having low coefficient of friction and long wearing qualities when operated on guide rails receiving infrequent light applications of rail lubricant.
- .4 Do not use gibs containing graphite or extreme pressure type lubricants which may adversely affect performance of safety.
- .5 Use solid type guide shoes for car, of metal construction, fitted with renewable cast-iron wearing gibs or inserts.

2.16 GUIDE RAILS AND BRACKETS

- .1 Erect guide rails plumb and parallel within maximum deviation of 3 mm.
- .2 Use metal shims only and provide lockwashers under all nuts and tapped bolts.
- .3 Compensate for expansion and contraction of guide rails.
- .4 Use splice plates and guide rails with contact surfaces accurately machined to form smooth joints.
- .5 In steel structures, bolt or weld brackets directly to steel hoistway framing.
- .6 In concrete structures, provide inserts in concrete formwork or self-drilling expansion shell bolt anchors for support of brackets. Where Departmental Representative considers any concrete fastener improperly installed, either replace fastener or demonstrate stability of fastener by performing on site test under which fastener is subjected to four times manufacturer's safe pullout or working load. Use self-drilling expansion shell bolt anchors only in solid concrete.
- .7 Anchor guide rails in pit so as not to reduce effectiveness of waterproofing.
- .8 Include steel reinforcement and backing for car guide rails where necessary.

2.17 GUIDE RAIL LUBRICATORS

- .1 Include guide rail lubricators to distribute oil evenly.
- .2 Include oil tight drip pan beneath each guiderail in pit.

2.18 CYLINDER AND PLUNGER

- .1 Construct plunger of selected steel tubing machined true and finished to surface finish of 0.0008 mm roughness height rating or better.
- .2 Design and install cylinder and plunger plumb. Operate with minimum friction.
- .3 Do not use a plunger follower guide.

2.19 PUMPING UNIT

- .1 Design pumping unit as an integral unit combining motor, pump, valves and reservoir in one enclosure.
 - .2 Reduce airborne noise with sound deadening material on inside of enclosure or submerge pump and motor in oil reservoir.
 - .3 Provide swing panels or panels equipped with quick release fasteners for convenient access to parts of equipment requiring adjustment.
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- .4 Use positive displacement screw-type pump, with multiple V-belt connection to drive motor or with direct connection between drive motor and pump through flexible coupling, specially designed for quiet service.
- .5 Install thermostatically controlled heaters if required, or other means to maintain fluid viscosity within limits necessary to provide consistent, reliable operation at all times.
- .6 Install thermostatic protection for high oil temperature in reservoir where pump or motor is submerged in reservoir.

2.20 MOTOR

- .1 Do not exceed EEMAC design B locked rotor current.
- .2 Design for minimum locked rotor torque of 150% and minimum breakdown torque of 200% at normal voltage.
- .3 Provide data plate on motor showing motor connections.
- .4 Where reduced voltage starting is provided, switch to full voltage not more than 1.5 seconds after interlock circuit is established.
- .5 Limit starting current of elevator motor to not more than 4 times full load running current.
- .6 Include class B motor insulation.
- .7 Include manually reset integral overheating protection to CSA C22.2 NO.77.

2.21 MUFFLER

- .1 Minimize transmission of fluid pulsations in pipeline between pumping unit and cylinder head with blow-out proof muffler.

2.22 PIPING

- .1 Use threaded couplings or mechanical couplings which mechanically prevent separation of adjoining members.
- .2 Welding is permitted providing interior of pipe is thoroughly cleaned after welding or where welding method prohibits introduction of foreign material into interior of pipe.
- .3 Provide sound isolation couplings in pipeline between pump and cylinder.
- .4 Locate piping where it can be serviced.

2.23 OIL STORAGE TANK

- .1 Provide oil storage tank capacity equal to volume of oil required to lift elevator to top terminal plus reserve or not less than 45 L.
- .2 Clearly indicate minimum permissible oil level.

2.24 LOW OIL CONTROL

- .1 Provide low oil control feature designed to automatically cause up-travelling car to descend to lower terminal landing if reservoir oil level is insufficient.
- .2 Arrange control so that oil reservoir is refilled before elevator can be returned to service.
- .3 Open car and hoistway doors automatically at lower terminal landing. Inactivate control buttons in car operating panel, except door-open button, and close hoistway doors.

2.25 EMERGENCY LIGHTING

- .1 Include emergency lighting in each car operating panel as follows:
 - .1 Battery operated emergency lighting equipment, to CSA C22.2 No.141, to provide general illumination and 10 lx minimum illumination in car at operating panels and telephone cabinet for 4 hours minimum.
 - .2 Key operated switch for manual testing of unit from within car.
 - .3 Battery unit of sufficient strength to support 90 kg person without causing malfunction or damage.
 - .4 Means to contain leakage or spillage of electrolyte.

2.26 CAR PLATFORM

- .1 Include car platforms as follows:
 - .1 Provide structural steel car platform frame filled with 38 mm plywood subflooring.
 - .2 Provide threshold plate of aluminium to ASTM B221 alloy 6351-T6.

2.27 CAR ENCLOSURE

- .1 Fabricate car enclosure on 3 sides of 1.9 mm thick steel with spaces between and adjacent to removable panels finished in plain colour baked enamel.
- .2 Install, removable panels retained securely with hidden fastenings. Design for removal of panels from inside car.
 - .1 Face panels: stainless steel sheet . Provide 100 mm stainless steel base three sides of car.
- .3 Flooring: in accordance with Section 09 68 13.
- .4 Ceiling: stainless steel panels as provided by elevator manufacturer.
- .5 Include overall Light Emitting Diode (LED) ceiling lighting with GU-10 lamps, sound rated A, with solid stainless steel ceiling panels, supported on baked enamel hung type ceiling frame. Design for light intensity measured 0.75 m above floor of 215 lx maximum. Totally enclose and conceal wiring and ballasts from view within the car and finish ceiling cavity white.
- .6 Fabricate front return panels, 15° sloped soffit and entrance columns of integral stainless steel. Provide front return with integral car operating panel.
- .7 Ventilate by an exhaust air handling unit through roof and through concealed perforations at base.
- .8 Limit total fan noise to 55 dB on "A" scale of General Radio Sound Level meter type 1551A from reading 0.9 m above floor with fan on high speed.

- .9 Mount air handling unit on top of car and effectively sound isolate system from car to prevent transmission of vibration to car structure.
- .10 Include two speed operation of ventilationsystem: approximately 330 dm³/s on high speed; approximately 165 dm³/s on low speed.
- .11 Provide pad hooks in car and one complete set of protective pads.
- .12 Include telephone cabinet in car with telephone symbol 75 mm and wording "In case of emergency, lift receiver, wait for answer" engraved in letters at least 6 mm high on outside cover. Fill engraved wording with orange phosphorescent paint. Identify elevator and name of building on back of cabinet cover. Include telephone wiring within elevator hoistway.
- .13 Use bolts fitted with washers and lock washers and fabric separators, if necessary to assemble and guarantee entire structure to operate entirely free from squeaks and metallic sounds.
- .14 Finish car side of car doors in stainless steel to match front of car.
- .15 Fabricate car enclosure of metal with minimum of ledges, projections and corners and finish in plain colour baked enamel with final coat brought to semi-gloss finish.
- .16 Use sheet steel, smooth and free from defects, 1.9 mm minimum thick.
- .17 Construct of one piece panels from floor to soffit, securely bolted together and to adjoining members with lightproof joints and reinforced to provide rigidity.
- .18 Provide perforations in base on three sides and in ceiling on four sides to allow air to circulate as car travels through hoistway.
- .19 Provide 2300 mm clear height under fixed hung car ceiling.
- .20 Provide clear car entrance height of 2135 mm.
- .21 Design floor to accept hard non-skid materials., flush with sill, with minimum fastenings and with securely held front edge.

2.28 CAR DOOR OPERATOR

- .1 Include motor driven electric operator on car to automatically open and close car door.
- .2 Open door when car has stopped at landing.
- .3 Close door upon momentary pressure of either car or landing call buttons, provided hoistway doors are closed.
- .4 Provide smooth opening and closing and cushioning at final limits on door travel.

2.29 CAR AND HOISTWAY DOOR OPERATOR

- .1 Operate car and hoistway doors at each hoistway entrance simultaneously, quietly and smoothly, without vibration, slam or shock, by electric operator located on car.
- .2 Open doors automatically as car is levelling.

2.30 DOOR PROTECTIVE DEVICE

- .1 Include door protective device extending full height of clear opening and projecting beyond leading edge of each door panel.
- .2 Should this device touch person or object while car door is closing, return car and hoistway doors to open position.
- .3 Arrange to retract noiselessly at both limits of travel.
- .4 Design and adjust device to cause doors to stop and reopen before doors contact object or person.

2.31 LIGHT RAY DEVICE

- .1 Include additional door protection by means of two horizontal infra-red light rays projected across elevator car entrance approximately 125 mm and 740 mm respectively above threshold.
- .2 After stop is made, hold doors open for predetermined adjustable interval, unless closing is initiated sooner by registration of car call.

2.32 CAR AND HOISTWAY DOOR HANGERS AND GIBS

- .1 Include two-point suspension door hangers for each door panel with resilient sound absorbing wearing surfaces and replaceable hanger tracks.
- .2 Use ball or roller bearings sealed to retain grease lubrication and wipers to maintain rollers and track in clean condition.
- .3 Absorb upthrust with adjustable eccentric rollers equipped with ball or roller bearings.
- .4 Design for replacement of gibs without removing door from hanger tracks.

2.33 METAL ENTRANCES

- .1 Furnish at all floors, elevator entrances as shown on plan, having clear openings 914 mm x 2135 mm and one-speed doors.
- .2 Assume complete and undivided responsibility for entire installation including doors, frames, structural supporting angles, headers, fasciae or toeguards, hangers, and sills.
- .3 Cushion opening doors with rubber bumpers and closing doors with rubber bumpers on strike jambs.

2.34 FLUSH TYPE HOISTWAY DOORS

- .1 Construct doors of flush type steel sheets for typical floors. Use stainless steel for lobby side of hoistway doors on both floors.
 - .2 Reinforce doors to receive attachments and to withstand strains due to power operation.
 - .3 Include sight guards.
-

2.35 UNIT FRAME WITH INTEGRAL TRIM

- .1 Construct frame for typical floors of steel as indicated, combining rough buck, jamb and casing in one piece welded, bolted construction.
- .2 Bolt frame to sill or sill extension and secure to header at top.
- .3 Use stainless steel for unit frames on both floors.

2.36 FIRE RATED ENTRANCES

- .1 Provide fire protection rated elevator closures, produced under label service program of ULC or other agency acceptable to FCC and authorities having jurisdiction.
- .2 Affix ULC or other acceptable agency label to elevator closures.

2.37 SILLS

- .1 Include extruded aluminum sills with anti-slip wearing surfaces to ASTM B221 alloy 6351-T6.
- .2 Grout sills in position providing up to 50 mm in thickness as required.
- .3 Include sill supports, where required and design for class of loading.
- .4 Do not use exposed fastenings.

2.38 FASCIAE OR TOEGUARDS

- .1 Include steel fasciae or toeguards 1.5 mm thick minimum where necessary to reduce running clearance to 30 mm.
- .2 Extend fasciae and toeguards at least 75 mm beyond clear entrance.

2.39 CONTROLLERS AND CABINETS

- .1 Enclose controllers in enameled ventilated sheet steel cabinets. Include hinged doors for easy access to CSA C22.2 No.14.
- .2 Include direct current operating and control circuits.
- .3 Provide similar switch and relay units of the same manufacturer and clearly identify controller components and terminal connections to agree with wiring diagrams.
- .4 Use two main line contractors to avoid possibility of continued operation of pump if one switch should fail.

2.40 HALL LANTERNS

- .1 Include single hall lanterns with single stroke gongs at terminal landings.
- .2 When car has reached predetermined distance from floor, and is going to stop at that floor, illuminate corresponding lantern and sound gong in advance of stop. Maintain lantern illumination until car has left the landing.
- .3 Use arrow-shaped lantern indicators coloured white with lens which project at least 19 mm from faceplate.

2.41 BUTTON ILLUMINATION

- .1 Include integral illumination of each button in each landing and car operating fixture.
- .2 Illuminate corresponding "up" or "down" button and car button whenever call is registered. Extinguish illumination when call has been answered.

2.42 SIGNAL ILLUMINATION

- .1 Illuminate signal fixtures with sufficient intensity to produce distinct and well-defined indications under ambient lighting conditions.

2.43 BILINGUAL

- .1 Engrave identification and instructions at least 0.25 mm deep on operating panels and on all signal equipment in both English and French except where design is such that inference is obvious and readily understood.

2.44 OPERATING PANEL AND BUTTONS

- .1 Install one operating panel per car with stainless steel faceplate on side panels in each car, include buttons with integral illumination corresponding to floors served, Include
 - .1 Keyed emergency stop switch.
 - .2 Alarm button.
 - .3 Keyed independent operation switch.
 - .4 Keyed service switch for hoistway access.
 - .5 Light switch.
- .2 Locate a 110 volt, single phase, 15 Amp GFCI receptacle below service cabinet.
- .3 Provide means for hands-free two-way communication, including speaker and microphone, integral within the car operating panel, along with appropriate instructions for use. Communication from within the car to be automatically activated by pressing HELP button mounted within the panel. Communication device to have capability of auto-dialing a primary and secondary response location and providing information relative to elevator location on demand. All other Code requirements for communication to be provided.
 - .1 Incorporate telephone into the bridge communication system.
 - .2 Telephone shall be capable of making outgoing calls and receiving incoming calls. Incoming calls shall not require in-car activation of telephone unit in order to initiate communication.
- .4 COP layout design to be approved by engineer.

2.45 KEY SWITCHES

- .1 Provide manufacturer's standard keying system. Provide a minimum of five copies of each key used.

2.46 FINISHING

- .1 Structural metal surfaces: clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- .2 Machine room components: clean and degrease; prime one coat, one coat enamel.

- .3 Galvanized surfaces: clean with neutralizing solvent; prime one coat.

2.47 HOISTWAY ACCESS

- .1 Provide cartop access by means of a keyed access system. Locate access switch in or near top floor door frames. Access switch shall be enabled from keyed switch within the car. The access switch shall be of continuous-pressure spring-return type with the key removable only when in the off position. Car speed not to exceed 0.75 m/sec.
- .2 Provide pit access by means of lunar key or approved equivalent.
- .3 Provide mechanical unlocking devices on all entrances, including those with access key switch.

2.48 CARTOP CONTROLS

- .1 Provide car top operation station, complete with guarded light, 110 volt 15 amp. receptacle, INSPECTION and STOP control buttons, as well as car direction buttons.
- .1 Fixture shall be mounted to car crosshead, and be readily accessible from landing side of hoistway.
- .2 Receptacle shall be GFCI type.

2.49 PIT

- .1 Install a switched guarded light fixture in the pit. Locate switch in the hoistway near and easily reachable from jamb side of door.
- .2 Install a GFCI receptacle in the pit.
- .3 Install stop switch.

2.50 ARRANGEMENT OF EQUIPMENT

- .1 Arrange equipment in machine room so that equipment can be removed for repairs or replacement without dismantling or removing other equipment components.
- .2 Accommodate equipment in space indicated.

Part 3 EXECUTION

3.1 INSPECTION

- .1 Verify that hoistway, pit and machine room are ready for equipment installation.
- .2 Verify shaft and openings are of correct size and within tolerances.
- .3 Confirm electrical power is available and of correct characteristics.
- .4 Report defects in writing to Engineer.

3.2 INSTALLATION

- .1 Install hoistway and machine room components in accordance with ASME A17.1/CSA B44, and any subsequent updates applicable at the time of bidding, local codes and regulations.

- .1 Set entrances in perfect alignment with car openings and true with plumb hoistway lines.
- .2 Install elevator closures in accordance with labeling requirements.
- .2 Arrange equipment in machine room so that functioning equipment and other equipment can be removed for repairs or replacement without dismantling or removing other equipment components. Arrange for clear passage to access door. Accommodate equipment in space indicated.
- .3 Bolt or weld brackets directly to structural steel hoistway framing.
- .4 Mount copy of master schematic wiring diagrams in framed glass or plastic enclosure on machine room wall.
- .5 Install lubrication chart in framed glass or plastic enclosure on machine room wall.

3.3 FIELD QUALITY CONTROL

- .1 Perform and meet tests required by ASME A17.1/CSA B44.
- .2 Supply instruments and carry out additional specified tests.
- .3 Furnish test and approval certificates issued by jurisdiction authorities.
- .4 Provide 2 weeks written notice of date and time of tests.

3.4 PROTECTION

- .1 Provide protective coverings for finished surfaces.

3.5 TOUCH-UP

- .1 Upon completion, touch up and restore to new condition, damaged or defaced factory finished surfaces.
- .2 Remove protective coverings and clean exposed surfaces after completion.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Common work results for Division 22 and Division 23.
- .2 Related Sections:
 - .1 Section 07 84 00 - Fire Stopping
 - .2 Section 09 91 99 – Painting for Minor Works

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
 - .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .3 Submit for approval within 4 weeks after Award of Contract.
 - .4 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .5 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.
 - .6 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
 - .7 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
-

- .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
 - .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .8 Site records:
 - .1 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 reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .9 As-built drawings and specifications:
 - .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 and specifications.
 - .5 Submit completed reproducible as-built drawings and specifications with Operating and Maintenance Manuals.
-

- .10 Submit copies of as-built drawings and specifications for inclusion in final TAB report.

1.3 HALOCARBONS

- .1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.5 MAINTENANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Complete list of equipment and materials to be used on this project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

Part 3 EXECUTION

3.1 REPAIRS/RESTORATION

- .1 To Section 09 91 99.
- .2 Prime and touch up marred finished paintwork to match original.

- .3 Restore to new condition, finishes which have been damaged extensively for priming and touch-up.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - 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 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Where specified elsewhere in Division 22 or 23 manufacturers to provide demonstrations and instructions.
- .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.

3.5 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 14-10, Standard for the Installation of Standpipe and Hose Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit complete plans to Authority of Jurisdiction for review and approval before commencement of work.
 - .3 Indicate grooved joint couplings and fittings on drawings.
- .4 Samples:
 - .1 Submit the following samples:
 - .1 Firehose nozzles.
 - .2 Section of hose.
- .5 Test reports:
 - .1 Submit certified test reports for standpipe and hose assembly from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .7 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for standpipe and hose system for incorporation into manual specified in Section 01 78 00.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .2 Installer: company or person specializing in standpipe and hose assembly with 5 years documented experience.
-

- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 21.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design system to NFPA 14 and following parameters:
 - .1 Stand alone: hydraulic.
 - .2 Combined with sprinkler systems: hydraulic.

2.2 SUSTAINABLE REQUIREMENTS

- .1 Grooved couplings and fittings made from minimum 90% recycled metal.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .2 Ferrous: to NFPA 14.
 - .3 Copper tube: to NFPA 14.
 - .2 Fittings and joints to NFPA 14:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed.
 - .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, grooved, OS&Y gate.
-

- .3 NPS 2 1/2 and over: cast or ductile iron, roll grooved ends, indicating butterfly valve.
- .4 Check valves: spring actuated swing type, composition disc or seal.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.
- .5 Drain valve: NPS 1, complete with hose end, cap and chain.
- .6 Inspector's test connections: NPS 1 gate valve.

2.4 CABINETS

- .1 To NFPA 14 and ULC listed: flush type as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with hinge same side as water supply and latching device.
- .2 Cabinets to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: Full metal door with lockable latch. Latch to be keyed to building master. Request master key from Department Representative.
- .4 Large enough to accommodate angle valve, hose rack, fire hose nozzle, fire extinguisher and NPS 2 1/2 fire department valve. Spanner to be excluded from the cabinet.
- .5 Cabinet dimensions to not exceed 762mmx762mmx203mm deep.

2.5 HOSE RACK

- .1 ULC listed, swivel type with pins to permit hose to be hung in folds. Locking device shall prevent flow of water into hose until last fold is removed from rack. Complete with hose, nozzle and angle valve.

2.6 FIRE HOSE AND NOZZLE

- .1 Hose: ULC listed, 38 mm nominal diameter, 30 m long, synthetic jacket, synthetic rubber lined.
- .2 Nozzle: ULC listed, 38 mm nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.7 ANGLE VALVES

- .1 ULC listed for fire service. NPS 1 1/2 cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device.

2.8 PRESSURE GAUGES

- .1 90 mm diameter, to Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.

2.9 FINISHES

- .1 In finished areas, chrome plate valves, nozzles, fittings and hose rack.
 - .2 Cabinets.
-

- .1 Tub: prime coated.
- .2 Door and frame: No. 4 satin finish stainless steel.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install and test to acceptance in accordance with NFPA 14.
- .2 Install pipework in accordance with Section 23 05 05, supplemented as specified.
- .3 Run inspectors test connections to sight glass.
- .4 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.
- .5 Install 90 mm diameter pressure gauge in accordance with Section 23 05 19.01 at top of risers and in accordance with NFPA 14.
- .6 The source of the water supply shall be reliable and capable of providing the required supply for not less than 30 minutes.
- .7 Water supply for standpipe system:
 - .1 Class III Systems:
 - .1 Receive water supply from source sufficient to provide 1892.50 lpm for single standpipe and 946.25 lpm for each additional standpipe.
 - .2 Total supply not to exceed 946.25 lpm.
 - .3 System: capable of maintaining residual pressure of 690 kPa at each top most outlet with 1892.50 lpm flowing from most remote standpipe and 946.25 lpm flowing from each additional standpipe up to maximum of 946.25 lpm flowing.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports 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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 SITE TEST

- .1 General:
 - .1 In accordance with NFPA 14, supplemented as specified.
- .2 Testing witnessed by Fire Commissioner of Canada and authority having jurisdiction.
- .3 Disposal of water used in flushing and testing:
 - .1 Discuss appropriate measures with Departmental Representative.
- .4 Timing:
 - .1 Connect fire hoses when flushing out and pressure tests have been completed.
 - .2 Charge system with water when there is no possibility of freeze-up.
 - .3 Perform tests after pressure booster pumps have been tested.
- .5 Co-ordination:
 - .1 Co-ordinate tests with performance verification of:
 - .1 Fire alarm systems specified Section 28 31 00.
 - .2 Wet pipe sprinkler systems specified Section 21 13 13.
- .6 Procedures:
 - .1 Verify that system is complete prior to start-up and testing procedures.
 - .2 Verify that ULC labels are visible.
 - .3 Fill system with water for pressure. Record water supply pressure.
 - .4 Pressure test piping system as required by authority having jurisdiction.
 - .5 Verify flow switches are operational.
 - .6 Verify valves in system are visible and monitored.
 - .7 Flushing: fill with water, let stand at operating pressure for 1 week. Drain risers separately, then drain main.
 - .8 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.
 - .9 Perform flow tests, including tests of pre-action systems, as required by:
 - .1 Authority having jurisdiction.
 - .2 Applicable NFPA standards such as 13, 14, 1273.
 - .3 Local building codes.
 - .10 Record incoming pressure to building for 10 days prior to activating system.
 - .11 Adjust PRV to maximum pressure of 620 kPa at top fire hose station.
 - .12 Adjust PRV's at lower fire hose stations to 550 kPa maximum.
 - .13 Confirm proper operation of backflow preventers.
 - .14 Adjust pressure switches.
- .7 Sundry checks:
 - .1 Verify that properly sized pressure restricting discs are installed where required.
- .8 Identification:
 - .1 Verify devices are properly labelled, identifying area served, etc.

- .9 Report:
 - .1 Refer to Section 01 91 00, reports supplemented as specified.
 - .2 In addition to reports required by NFPA 14, include the following:
 - .1 Copy of schematic and valve schedule.
- .10 Posted Instructions:
 - .1 Prepare schematic, mount behind glare-free glass and install where directed.
 - .2 Prepare valve schedule, mount behind glare-free glass and install where directed.
- .11 Training:
 - .1 Refer to Section 01 91 00: Training of O&M Personnel.
- .12 Documentation:
 - .1 Provide written certification to Departmental Representative that system was installed, flushed and tested in accordance with appropriate codes, approved plans and calculations.
 - .2 Certificate to include:
 - .1 Contractors name.
 - .2 Contractors address.
 - .3 Contractors license number.
 - .4 List of approved materials and devices installed.
 - .5 Description of system test conducted.
 - .6 Dates of flushing and testing.
 - .7 Certification that connections and welding conform to acceptable standards.
 - .8 Certification that system is complete and in service.
 - .9 Approved signage has been provided and attached as appropriate.
 - .10 Hose threads of system and test connections match those of responding fire department.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 25-2008, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S543-09, Standard for Internal Lug Quick Connect Coupling for Fire Hose.
 - .2 CAN/ULC-S543-09-AM1, Amendment 1 to Standard for Internal Lug Quick Connect Coupling for Fire Hose.
- .3 FC 403 – Standard for Sprinkler Systems
 - .1 Human Resources and Skills Development Canada, Effective November 1994.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
 - .4 Hydraulic Calculations:
 - .1 Submit hydraulic calculations stamped and signed by a professional engineer registered or licensed in the Province of Ontario, Canada for the designed system.
 - .5 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
-

- .2 Concealed sprinkler covers with colour matched to each ceiling finish.
- .3 Signs.
- .6 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .8 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .9 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 in accordance with NFPA 20.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.
 - .4 Water motor alarms.
 - .5 Sprinkler heads.
 - .6 Pipe hangers and supports.
 - .7 Pressure or flow switch.
 - .8 Fire department connections.
 - .9 Excess pressure pump.
 - .10 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:

- .1 Calculations of sprinkler system design.
- .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.
 - .3 As-built drawings to be stamped by a Professional Engineer registered in the Province of Ontario.
- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Sprinkler Contractors Material and Test Certificate for aboveground and other documentation for incorporation into manual in accordance with NFPA 13. Hydraulic calculations, as-built drawings, and Sprinkler Contractors Material and Test Certificate to be stamped by a Professional Engineer registered in the Province of Ontario.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .2 Installer: company or person specializing in wet sprinkler systems with 5 years documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

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

- .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for the hazard classification of the space.
 - .2 Space sprinklers on branch to suit architectural layout or ceiling components.
- .7 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.
- .8 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
 - .2 Application to horizontal surfaces below sprinklers shall be sized as per NFPA 13 density/area curves for hydraulically most remote area.
- .9 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote area as defined in NFPA 13.
- .10 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations of 189 lpm for outside hose streams.
- .11 Friction Losses:

- .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

.12 Water Supply:

- .1 Fire protection contractor to conduct flow test in vicinity of site to obtain current static and residual flow pressure measurements required for calculations.

2.2 SUSTAINABLE REQUIREMENTS

- .1 Grooved couplings and fittings made from minimum 90% recycled metal.

2.3 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.
- .3 Conceal piping in areas with suspended ceiling.

2.4 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .2 Ferrous: to NFPA 13.
 - .3 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed, grooved.
 - .3 Provide threaded fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
 - .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
 - .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
 - .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
 - .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
 - .8 Side outlet tees using rubber gasketed fittings are not permitted.
 - .9 Sprinkler pipe and fittings: metal.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.

- .3 Provide rising stem OS & Y valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
- .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
- .5 Provide gate valve in piping protecting elevator hoistways, machine rooms, and machinery spaces.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.5 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
 - .1 Upright: chrome deflector in finished areas, bronze in unfinished areas. Glass bulb type.
 - .2 Pendant: chrome glass bulb type.
 - .3 Recessed: chrome, glass bulb type with ring and cup
 - .4 Concealed: chrome, glass bulb type with ring and cup. Cover to match ceiling finish.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
 - .1 Release element of each head to be of temperature rating as suitable for specific application.
 - .2 Provide polished chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings.
 - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
 - .4 Deflector: not more than 75 mm below suspended ceilings.
 - .5 Ceiling plates: not more than 25 mm deep.
 - .6 Ceiling cups: not permitted.

2.6 ALARM CHECK VALVE

- .1 Alarm check valve to NFPA 13 and ULC listed for fire service.
- .2 Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for proper operation of system.
- .3 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.

2.7 SUPERVISORY SWITCHES

- .1 General: to NFPA 13 and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

- .3 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
 - .3 Connect into building fire alarm system.
 - .4 Connection of switch: Section 28 31 00.
 - .5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.8 EXCESS PRESSURE PUMP

- .1 Provide pumps on each sprinkler piping riser.
- .2 Pumps:
 - .1 Pumps: positive displacement, gear type rated at 1 lpm, integrally mounted with motor.
 - .2 Double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.
- .3 Pump and motor unit:
 - .1 Approved for automatic wet pipe fire extinguishing sprinkler systems; complete with pilot light panel, differential motor control switch, high pressure switch, and low pressure switch.
 - .2 EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50 degrees C, 0.25 kW, 120/1/60.
 - .3 Capacity: 7.6 L/min.
- .4 Provide electrical power supply connections for pump and pilot light panel at supply side of building service panel.
- .5 Provide separate fused safety-type switch with locked lever for each connection.
- .6 Pump operation switch: to operate excess pressure pump with pressure differential of 103 kPa.
- .7 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.

2.9 PRESSURE GAUGES

- .1 ULC listed and to Section 23 05 19.01.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

2.10 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors.
- .2 Secure sleeves in position and location during construction.

- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61mm thick galvanized steel sheet.

2.11 ESCUTCHEON PLATES

- .1 Provide one piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.12 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.13 SIGNS

- .1 Attach properly lettered and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

2.14 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Provide electrical work associated with this section under Section 26 05 00.
- .2 Provide fire alarm system under Section 28 31 00.
- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 DISINFECTION

- .1 Disinfect new piping prior to connecting to existing piping system.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Departmental Representative in writing at least 15 days prior to connection date.
 - .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
 - .3 Bolt sleeves around main piping.
 - .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
 - .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.
-

3.7 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
 - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
 - .3 Provide piping with 50 mm wide red enamel bands spaced at maximum of 6 m intervals throughout piping systems.
 - .2 Piping in Unfinished Areas:
 - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in spaces above suspended ceilings, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
 - .2 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.8 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .2 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
 - .3 Test, inspect, and approve piping before covering or concealing.
 - .4 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with NFPA 13.
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
-

- .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
- .6 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .6 Site Tests:
 - .1 Testing to be witnessed by Fire Commissioner of Canada and the authority having jurisdiction.
 - .2 Develop, with Departmental Representative assistance, detailed instructions for O & M of this installation.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Fire Commissioner of Canada (FC)
- .2 National Fire Prevention Association (NFPA)
 - .1 NFPA 10-07, Standard for Portable Fire Extinguishers.
- .3 Ontario Fire Code - 2007
- .4 National Fire Code - 2010

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire extinguishers and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide ULC listed maintenance data for incorporation into manual specified in Section 01 78 00.
- .3 Shop Drawings:
 - .1 Submit shop drawings for fire extinguishers and fire extinguisher cabinets noting:
 - .1 Size, Capacity, ULC rating
 - .2 Colour
 - .3 Bracket detail and construction

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations .
 - .2 Store and protect fire extinguishers 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 material as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

- .1 Multi-Purpose Dry Chemical
- .2 Size: As per mechanical schedules
- .3 Rating: As per mechanical schedules
- .4 Construction: Stainless Steel hose band and nozzle retainer. Machined aluminum valves. Aluminum and plated steel handles.
- .5 Design to NFPA 10.

2.2 FIRE EXTINGUISHER BRACKETS

- .1 Mounting brackets: Manufacturer's heavy duty, steel, designed to secure fire extinguisher to wall or structure. Sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- .2 Identification:
 - .1 Identify extinguishers in accordance with recommendations of ULC S508.
 - .2 Attach tag or label to extinguishers, indicating month and year of installation; include space for service dates.
 - .3 Identify bracket-mounted fire extinguishers with the words FIRE EXTINGUISHER in red letter decals applied to mounting service.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examine walls and partitions for framing and suitable mounting service for brackets. Coordinate with fire hose cabinets for suitable room and placement within cabinets.
- .2 Examine fire extinguishers for proper charging and tagging; remove and replace damaged, defective, or undercharged units.

3.2 INSTALLATION

- .1 Install in accordance with ULC listing.
- .2 Provide fire extinguishers as indicated on drawings.
- .3 Fasten mounting brackets to surfaces, square and plumb, at locations indicated. Coordinate with other sub-trades and Departmental Representative.

3.3 CLEANING

- .1 Remove temporary protective coverings and strippable films as fire protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- .2 Wipe clean exterior surfaces of fire extinguishers.
- .3 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for plumbing pumps.

1.2 RELATED SECTIONS:

- .1 Section 21 05 01 – Common Work Results – For Mechanical
- .2 Section 25 90 01 – EMCS: Site Requirements, Applications and System Sequences of Operation

1.3 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
 - .2 Submit WHMIS MSDS in accordance with Section 01 33 00. Indicate VOC's for adhesive and solvents during application and curing.
 - .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.
 - .5 Electrical disconnects and starters.
 - .6 Control diagram.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturers' Field Reports: manufacturers' field reports specified.
 - .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00, include:
 - .1 Manufacturers name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing and maintenance.
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- .3 Recommended spare parts list with names and addresses.

1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
- .2 Convene pre-installation meeting two weeks prior to beginning work of this Section and on-site installations in accordance with Section 01 31 19.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 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.
 - .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
 - .4 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
 - .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 ELEVATOR SUBMERSIBLE SUMP PUMP

- .1 Capacity: as indicated on mechanical schedules.
 - .2 Construction: simplex CSA approved, housing epoxy coated cast iron, carbon steel shaft, non-clog engineered glass fiber thermoplastic impeller, mechanical shaft seal.
 - .3 Motor: as indicated, hermetically sealed, with automatic overload protection and automatic reset.
 - .4 Control: Complete with NEMA 4x controller and oil sensing system. The system shall be capable of pumping water while containing oil. The control panel shall include a high decibel warning horn buzzer complete with alarm silencing switch.
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- .5 Oil sensor probe: hermetically sealed, heavy duty, stainless steel with low voltage self-cleaning technology. Oil sensing systems using optical lenses subject to dirt contamination and false alarms are not considered equal.
- .6 Floats: single float switch for pump activation and an additional high water alarm float.
- .7 Local alarms and remote dry contacts:
 - .1 Presences of oil in the sump
 - .2 High liquid level in the sump
 - .3 High amps or locked motor rotor.
- .8 Sump pump to be capable of passing 20mm sphere.
- .9 The power cord shall be of length to suit installation condition.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .2 Check power supply.
 - .3 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 00: General Requirements, supplemented as specified herein.
 - .2 Procedures:
 - .1 Check power supply.
-

- .2 Check starter O/L heater sizes.
- .3 Start pumps, check impeller rotation.
- .4 Check for safe and proper operation.
- .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
- .6 Test operation of hands-on-auto switch.
- .7 Adjust leakage through water-cooled bearings.
- .8 Adjust shaft stuffing boxes.
- .9 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
- .10 Check base for free-floating, no obstructions under base.
- .11 Run-in pumps for 12 continuous hours.
- .12 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
- .13 Adjust alignment of piping and conduit to ensure full flexibility.
- .14 Eliminate causes of cavitation, flashing, air entrainment.
- .15 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .16 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .17 Verify lubricating oil levels.
- .3 Verify operation and control of over-temperature protection devices.

3.5 PV - SUMP PUMPS

- .1 Application tolerances:
 - .2 Flow: plus 10%; minus 0%.
 - .3 Pressure: plus 10%; Minus 5%.
- .2 PV Procedures:
 - .1 Fill sump at rate slower than capacity of pump.
 - .2 Record levels at which pump starts and stops. Determine flow rate by observing time taken to down water level.
 - .3 Adjust water level controls as necessary.
 - .4 Check level at which high water level alarm starts and stops. Adjust as necessary.
- .3 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
- .4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.6 REPORTS

- .1 In accordance with Section 01 91 00: reports, supplemented as specified.
- .2 Include:

- .1 PV results on approved PV Report Forms.
- .2 Product Information report forms.
- .3 Pump performance curves (family of curves) with final point of actual performance.

3.7 TRAINING

- .1 In accordance with Section 01 91 00: Training of O&M Personnel, supplemented as specified.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 33 – Heat Tracing for HVAC Piping and Tanks.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-2011, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
 - .2 ANSI B16.18-01(R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-01(R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-2001(2006), Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .2 ASTM International Inc. (ASTM)
 - .1 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube (Metric).
 - .3 American Water Works Association (AWWA)
 - .1 AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .4 Canadian Standards Association (CSA International)
 - .1 CSA B242-05(R2011), 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-67-2002a, Butterfly Valves.
 - .2 MSS-SP-70-2006, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
 - .8 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 47668, National Plumbing Code of Canada (NPC) - 2010.
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- .9 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .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.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 35 45.
- .2 Packaging Waste Management:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: roll grooved to CSA B242.

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
 - .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
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- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 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.
- .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.
- .3 NPS 2-1/2 and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02.
- .4 NPS 2-1/2 and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02.

2.5 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01.
 - .2 Lockshield handles: all balancing valves.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01.
 - .2 Lockshield handles: all balancing valves.

2.6 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .2 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01.

- .3 NPS 2-1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.02.

2.7 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01.

2.8 BUTTERFLY VALVES

- .1 NPS 2-1/2 and over, wafer:
 - .2 To MSS-SP-67, Class 200.
 - .3 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
 - .4 Lever operated, NPS8 and over, gear operated.
- .2 NPS 2-1/2 and over, grooved ends:
 - .1 Class 300, bubble tight shut-off, bronze body.
 - .2 Operator:
 - .1 NPS 4 and under: lever handle.
 - .2 NPS 6 and over: gear operated.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with NPC, and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

- .1 Isolate equipment, fixtures and branches with gate or ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.
- .2 Submit laboratory test samples to Departmental Representative and receive written approval to connect new piping system to existing domestic water system prior to final tie-ins.

3.6 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

- .1 Flush out, disinfect and rinse system to approval of Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.8 START-UP

- .1 Timing: Start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
 - .2 Provide continuous supervision during start-up.
 - .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
-

- .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
- .3 Bring DHWT storage tank up to design temperature slowly.
- .4 Monitor piping DHW and DCW piping systems for freedom of movement, pipe expansion as designed.
- .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .2 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize DHW systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 Check for proper operation of water hammer arrestors. Run three outlets for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .7 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 00: Reports, using report forms as specified in Section 01 91 00: Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 21 05 01.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM B32-08, Standard Specification for Solder Metal.
 - .2 ASTM B306-09, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-11, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CSA B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-11, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary and vent Type DWV to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.3.
 - .2 Wrought copper: to CAN/CSA-B125.3.
-

- .2 Solder: lead free, tin- copper alloy 95:5, to ASTM B 32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm, and vent minimum NPS 1.5, to: CSA B70
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets: to CSA B70.
ASTM C564 or
 - .2 Stainless steel clamps.
 - .2 Above ground sanitary, storm, and vent: to CSA B70.
 - .1 Joints:
 - .1 Mechanical joints:
 - .3 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 In accordance with Section 23 05 01.
- .2 Install in accordance with National Plumbing Code, and local authority having jurisdiction.

3.3 TESTING

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

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .2 Ensure accessible and that access doors are correctly located.
 - .3 Open, cover with linseed oil and re-seal.
 - .4 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
 - .1 ANSI Z21.10.3A-2007/CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
 - .2 Canadian Standards Association (CSA International)
 - .1 CSA B51-03(R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish, trim, and controls.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Performance characteristics as indicated within mechanical schedules.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

1.5 WARRANTY

- .1 Provide a 3-year limited tank warranty.

Part 2 PRODUCTS

2.1 DHW HEATER TANK

- .1 General: Design-certified by CSA International, according to ANSI Z21.10.3 – CSA 4.3 standards governing storage-type water heaters, stamped for 1100 kPa working pressure. Meets or exceeds the thermal efficiency and standby loss requirements of ASHRAE 90.1 – 2010.
- .2 Capacity: as indicated in mechanical schedules.
- .3 Efficiency: at least 95%.
- .4 Burner: To be capable of precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up
- .5 Construction: To be seamless glasslined steel tank. Glass lining to be applied to all water-side surfaces after the tank has been assembled and welded. Domestic water heater to be approved for 0cm clearance installation to combustibles.
- .6 Controls:
 - .1 Integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display and shall have a digital temperature readout.
 - .2 Domestic hot water controls shall be capable of communicating with building management system using the BACnet communication protocol.
 - .1 The following points at minimum must have read/write capability:
 - .1 Temperature set point
 - .2 Enable/Disable
 - .2 The following points at minimum must have read capability:
 - .1 Tank temperature
 - .2 Status
 - .3 Run-Hours
 - .4 Current Fault
 - .3 Flow switch and low water cut out, interlocked with ignition system to prevent operation in event of low flow or low water level.
 - .3 Venting and Combustion Air: Domestic hot water heater shall be suitable for power direct venting. Provide domestic hot water heater with a concentric vent kit suitable for side-wall termination.

2.2 TRIM AND INSTRUMENTATION

- .1 Drain valve: NPS 1 with hose end.
 - .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
 - .3 Pressure gauge: 75 mm dial type with red pointer, and shut-off cock.
 - .4 Thermowell filled with conductive paste for control valve temperature sensor.
 - .5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
 - .6 Maintenance free powered anode.
-

- .7 Provide condensate neutralization kit, sized for peak condensate flow rate.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Install natural gas fired domestic water heaters in accordance with CAN/CSA-B149.1.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and assist in commissioning DHW heaters.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .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 20.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.
 - .3 Equipment not installed.
 - .1 Capped for future connection by others.

1.2 RELATED SECTIONS:

- .1 Section 22 42 01 – Plumbing Specialties and Accessories.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.
 - .2 CSA-B125.3-11, Plumbing Fittings.
 - .3 CAN/CSA-B651-04(R2010), Accessible Design for the Built Environment.
- .2 American Society for Mechanical Engineers (ASME)/Canadian Standards Association (CSA International).
 - .1 ASME A112.18.1-2011/CSA B125.1-11, Plumbing Supply Fittings.
 - .2 ASME A112.18.2-2011/CSA B125.2-11, Plumbing Waste Fittings.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
 - .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00.
 - .1 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, certifications, roughing-in dimensions.
 - .2 Colour, mounting heights, and carriers.
 - .3 Water consumption and power requirements
 - .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
-

- .2 Details of operation, servicing, maintenance.
- .3 List of recommended spare parts.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
- .2 Do construction occupational health and safety in accordance with Section 01 35 30.

1.6 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
- .2 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Commercial Plumbing Fixtures:
 - .1 As specified on mechanical drawings
- .8 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Braided stainless steel flexible supply pipes each with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
- .9 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as per architectural elevations, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of either NBCC and CAN/CSA-B651.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for plumbing specialties and accessories.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B64 Series-11, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B356-00(R2005), Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Plumbing and Drainage Institute (PDI).
 - .1 PDI-WH201-92, Water Hammer Arresters Standard.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
 - .2 Indicate dimensions, construction details and materials for specified items.
 - .3 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, dimensions construction and assembly details and accessories for following:

- .1 Trap Primers
 - .2 PRV's
 - .3 Wall Hydrants
 - .4 Floor Drains
 - .5 Roof Drains
 - .6 Cleanouts
 - .7 Strainers
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00, include:
- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .2 Convene pre-installation meeting two weeks prior to beginning work of this Section and on-site installations in accordance with Section 01 31 19.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

- .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 FLOOR DRAINS

- .1 Floor Drains: as specified in mechanical schedules.

2.2 ROOF DRAINS

- .1 Roof Drains: as specified in mechanical schedules.

2.3 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 round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
- .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top cast box with anchor lugs and:
- .1 Plugs: bolted bronze with neoprene gasket.
- .2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.
- .3 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .4 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 NON-FREEZE WALL HYDRANTS

- .1 Recessed with integral vacuum breaker, NPS 3/4 hose outlet, removable operating key. Polished bronze finish. Cover to be complete with lock and key.

2.5 WATER HAMMER ARRESTORS

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

2.6 BACK FLOW PREVENTERS

- .1 Preventers: to CSA B64 Series, as indicated, reduced pressure principle type or double check valve assembly as indicated on mechanical drawings.

2.7 VACUUM BREAKERS

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

2.8 PRESSURE REGULATORS

- .1 Inlet pressure: as indicated on drawings.
- .2 Outlet pressure: as indicated on drawings.
- .3 Up to NPS1-1/2 bronze bodies, screwed: to ASTM B62.
- .4 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .5 Semi-steel spring chambers with bronze trim.

2.9 WATER MAKE-UP ASSEMBLY

- .1 Complete with backflow preventer, pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.10 TRAP SEAL PRIMERS

- .1 Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.

2.11 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS2 1/2 and over, cast iron body, flanged ends, with bolted cap.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 CLEANOUTS

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

3.4 NON-FREEZE WALL HYDRANTS

- .1 Install 600mm above finished grade unless otherwise indicated.
-

3.5 WATER HAMMER ARRESTORS

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

3.6 BACK FLOW PREVENTORS

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

3.7 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.
- .3 Install plastic tubing to floor drain.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket.

3.9 WATER MAKE-UP ASSEMBLY

- .1 Install complete with valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

3.10 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13: 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.

3.11 TESTING AND ADJUSTING

- .1 General:
 - .2 In accordance with Section 01 91 00: General Requirements, supplemented as specified.
 - .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
-

- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
 - .4 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
 - .5 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
 - .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
 - .7 Roof drains:
 - .1 Check location at low points in roof.
 - .2 Check security, removability of dome.
 - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
 - .4 Clean out sumps.
 - .5 Verify provisions for movement of roof systems.
 - .8 Access doors:
 - .1 Verify size and location relative to items to be accessed.
 - .9 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
 - .10 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
 - .11 Wall hydrants:
 - .1 Verify complete drainage, freeze protection.
 - .2 Verify operation of vacuum breakers.
 - .12 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.
 - .13 Strainers:
 - .1 Clean out repeatedly until clear.
-

- .2 Verify accessibility of cleanout plug and basket.
- .3 Verify that cleanout plug does not leak.
- .14 Hydronic system water Make-up Assembly:
 - .1 Adjust settings to suit location, flow rates, pressure conditions.
 - .2 Close by-pass valve after first fill.
- .15 Commissioning Reports:
 - .1 In accordance with Section 01 91 00: Reports, supplemented as specified.
- .16 Training:
 - .1 In accordance with Section 01 91 00: Training of O&M Personnel, supplemented as specified.
 - .2 Demonstrate full compliance with Design Criteria.

END OF SECTION

Part 1 GENERAL

1.1 USE OF SYSTEMS

- .1 Use of new and or existing permanent heating and or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage from any cause.
 - .5 Supply ventilation systems are protected by MERV 8 filters, which shall be inspected daily, changed every 2 weeks or more frequently as required.
 - .6 Return systems have approved filters over all openings, inlets, outlets.
 - .7 All systems will be:
 - .1 operated as per manufacturer's recommendations or instructions.
 - .2 operated by Contractor.
 - .3 monitored continuously by Contractor.
 - .8 Warranties and guarantees are not thereby relaxed.
 - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
 - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 09 91 99 – Painting for Minor Works.

1.2 TRIAL USAGE

- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.3 PROTECTION OF OPENINGS

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

1.4 PAINTING

- .1 To Section 09 91 99.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.5 SPARE PARTS

- .1 Furnish spare parts in accordance with Section 01 78 00 as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
 - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

1.6 SPECIAL TOOLS

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.
- .2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.7 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 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.
 - .2 Where specified elsewhere in Mechanical Divisions, manufacturers to provide demonstrations and instructions.
 - .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
-

- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Departmental Representative may record these demonstrations on video tape for future reference.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.
- .3 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.9 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
-

- .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.
- .3 Shop drawings and product data shall be 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 as to current model production.
 - .5 Certification of compliance to applicable codes and standards.
- .4 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.10 CLEANING

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

1.11 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark there on all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), 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 TAB to be performed using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .3 Submit copies of as-built drawings for inclusion in final TAB report.

1.12 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
- .4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.13 HALOCARBONS

- .1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 RELATED SECTIONS

- .1 Section 07 84 00 – Fire Stopping.
- .2 Section 23 08 02 – Clean and Start-up of Mechanical Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
 - .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
 - .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
-

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
 - .2 Protect openings against entry of foreign material.
 - .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
 - .4 Assemble piping using fittings manufactured to ANSI standards.
 - .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
 - .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
 - .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
-

- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate or ball valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Install plug cock or ball valves for glycol service.
 - .9 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .15 Check Valves:
 - .1 Install silent check valves on discharge of pumps and vertical piping.
 - .2 Install swing check valves in horizontal lines.

3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 supplemented as specified in Section 23 08 02.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
 - .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
 - .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
 - .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
 - .5 Conduct tests in presence of Departmental Representative.
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- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 10 working days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI/ASHRAE/IES).
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

1.2 SECTIONS INCLUDES

- .1 Electrical work to conform to Electrical Divisions including the following:
 - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Motors to be high efficiency, in accordance with the requirements of ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified in mechanical schedules and individual specification sections.

2.3 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 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 to be 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 centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00.

2.4 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 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.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Fasten securely in place.

- .2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A105/A105M-10a, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data in accordance with Section 01 78 00.
 - .1 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SLIP TYPE EXPANSION JOINTS

- .1 Application: for axial pipe movement, as indicated.
 - .2 Repacking: under full line pressure.
-

- .3 Body and packing housings: Class 150, 1MPa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe with raised face flanges to match pipe.
- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.
- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packing rings: 6 minimum, PTFE.
- .9 Thermal plastic packing: PTFE.
- .10 Lubricating fittings: pet cocks with grease nipple.
- .11 Plunger body and plunger:
 - .1 Plunger body: heavy wall carbon steel welded to body.
 - .2 Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.

2.2 BELLOWS TYPE EXPANSION JOINTS

- .1 For axial, lateral or angular movements, as indicated.
- .2 Maximum operating pressure: to suit operating pressure
- .3 Maximum operating temperature: 48 degrees C.
- .4 Type A: controlled flexing, factory tested to 1 ½ times maximum working pressure. Provide test certificates.
- .5 Bellows:
 - .1 Multiple bellows, hydraulically formed, single ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.
- .6 Reinforcing or control rings:
 - .1 2 piece nickel iron.
- .7 Ends:
 - .1 Flanges to match pipe.
- .8 Liner:
 - .1 Austenitic stainless steel in direction of flow.
- .9 Shroud:
 - .1 Carbon steel, painted.

2.3 FLEXIBLE CONNECTION

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: Stainless steel corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: Flanged or threaded, size to match pipe size.
- .6 Operating conditions:
 - .1 Working pressure: 1034 kPa.
 - .2 Working temperature: 50 degrees C.
 - .3 To match system requirements.

2.4 ANCHORS AND GUIDES

- .1 Alignment guides:
 - .1 To accommodate specified thickness of insulation.
 - .2 Vapour barriers, jackets to remain uninterrupted.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install expansion joints with cold setting. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.
- .4 Do welding in accordance with section 23 05 17.

3.3 PIPE CLEANING AND START-UP

- .1 In accordance with Section 23 08 02.

3.4 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01.
-

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.3-2006, Process Piping.
 - .2 ASME Boiler and Pressure Vessel Code BPVC-2010:
 - .1 BPVC 2010 Section I: Power Boilers.
 - .2 BPVC 2010 Section V: Nondestructive Examination.
 - .3 BPVC 2010 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206-13, 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 Canadian Standards Association (CSA International)
 - .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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to 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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.3, 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 applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

- .2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

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

3.5 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .2 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
 - .3 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .4 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") 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 particle tests.

3.6 DEFECTS CAUSING REJECTION

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

3.7 REPAIR OF WELDS WHICH FAILED TESTS

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

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP 2007 Version.
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .2 GS-36-11, Standard for Commercial Adhesives.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Submit drawings indicating type and range for each type of gauge and thermometer.
- .3 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test and Evaluation Reports:
 - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store thermometers and pressure gauges off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: as required for each system's expected minimum and maximum operating points.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.
 - .1 Resistance to shock and vibration.

2.3 REMOTE READING THERMOMETERS

- .1 100 mm diameter mercury-free liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass case for wall mounting.

2.4 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: stainless steel.

2.5 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm assembly for corrosive service.
 - .3 Gasketed pressure relief back with solid front.
 - .4 Bronze stop cock.
 - .5 Oil filled for high vibration applications.

Part 3 EXECUTION

3.1 EXAMINATION

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

3.2 GENERAL

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
 - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Water heating and cooling coils.
 - .2 Water boilers.
 - .3 Heat rejection units.
 - .4 DHW tanks.
- .3 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

- .1 Install in locations as indicated and as follows:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of PRV's.
 - .3 Upstream and downstream of control valves.
 - .4 Inlet and outlet of coils.
 - .5 Outlet of boilers.
- .2 Use extensions where pressure gauges are installed through insulation.

3.5 NAMEPLATES

- .1 Install engraved lamicoïd nameplates in accordance with Section 23 05 53.01, identifying medium.

3.6 CLEANING

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

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283/B283M-11a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-11, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
-

- .4 Valve handles: 2 of each size.
- .5 Gaskets for flanges: one for every 10 flanged joints, minimum 1.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends to ASME B16.18.
 - .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 2 keys of each size: malleable iron cadmium plated.
 - .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
 - .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
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- .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
- .2 Operator: Handwheel.
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B283/B283M, loosely secured to stem.
 - .3 Operator: handwheel.
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
- .5 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE, regrindable bronze seat, loosely secured to bronze stem to ASTM B505/B505M.
 - .3 Operator: handwheel.
 - .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505/B505M.
 - .3 Operator: handwheel.
 - .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
 - .3 Operator: handwheel.
 - .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.

- .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
- .3 Operator: handwheel.
- .6 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 NPS 2 and under, swing type, bronze disc:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .4 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
 - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
 - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 Silent Check Valves:
 - .1 NPS 2 and under:
 - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
 - .2 Pressure rating: Class 125.
 - .3 Connections: screwed ends to ANSI/ASME B1.20.1 and with hex. shoulders.
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.
- .8 Ball Valves:
 - .1 NPS 2 and under:

- .1 Body and cap: cast high tensile bronze to ASTM B62.
- .2 Pressure rating: Class125
- .3 Connections: screwed ends to ASME B1.20.1 and with hexagonal shoulders or solder ends to ANSI.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
- .7 Stem seal: PTFE with external packing nut.
- .8 Operator: removable lever handle.
- .9 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever or handwheel.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
- .2 Valves, gate, globe, and check.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
- .2 ANSI/ASME B16.1-2005, Cast Iron Pipe Flanges and Flanged Fittings.
- .3 American Society for Testing and Materials International (ASTM).
- .4 ASTM A49-01(2006), Specification for Heat-Treated Carbon Steel Joint Bars.
- .5 ASTM A126-04, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .6 ASTM B61-08, Specification for Steam or Valve Bronze Castings.
- .7 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
- .8 ASTM B85/B85M-09, Specification for Aluminum-Alloy Die Castings.
- .9 ASTM B209-10, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .10 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .11 MSS SP-70-2006, Gray Iron Gate Valves, Flanged and Threaded Ends.
- .12 MSS SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .13 MSS SP-82-1992, Valve Pressure Testing Methods.
- .14 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
- .15 American Petroleum Institute (API).
- .16 API 598-2009, Valve Inspection and Testing.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Submit shop drawings and product data in accordance with Section 01 33 00.
- .3 Submit data for valves specified in this section.
- .4 Closeout Submittals:
- .5 Submit maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .2 Do construction occupational health and safety in accordance with Section 01 35 29.
-

1.5 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
- .2 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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.

Part 2 PRODUCTS

2.1 MATERIAL

- .1 Sustainable Requirements:
 - .2 Cast iron: minimum 25% recycled content.
-

- .3 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
 - .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
 - .4 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: flanged ends plain face to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.
 - .5 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze or iron trim to suit application, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
 - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
 - .4 Stem: bronze to ASTM B62.
 - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
 - .6 Seat: Integral with body.
 - .7 Stem: wrought steel.
 - .8 Operator: Handwheel
- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze and iron trim to suit service, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

- .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
- .3 Seat rings: renewable bronze screwed into body.
- .4 Stem: nickel-plated steel.
- .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
- .6 Seat rings: integral with body.
- .7 Stem: nickel-plated steel.
- .8 Pressure-lubricated operating mechanism.
- .9 Operator: Handwheel.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC 262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
 - .12 Operator: handwheel.

2.4 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
 - .1 Body: with multiple-bolted bonnet.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP.
 - .3 Bonnet-yoke gasket: non-asbestos.
 - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B62.
 - .7 Operator: Handwheel

2.5 VALVE OPERATORS

- .1 Install valve operators as follows:
- .2 Handwheel: on valves except as specified.
- .3 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.

2.6 CHECK VALVES

- .1 Swing check valves, Class 125:
- .2 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
 - .2 NPS 18 and over: cast iron to ASTM A126 Class C.
- .3 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
 - .3 NPS 18 and over: 1.03 MPa CWP.
- .4 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B62.
 - .2 NPS 8 and over: bronze-faced cast iron.
- .5 Seat rings: renewable bronze to ASTM B62 screwed into body.
- .6 Hinge pin, bushings: renewable bronze to ASTM B62.
- .7 Disc: ASTM A126 Class B, secured to stem, rotating for extended life.
- .8 Seat: cast iron, integral with body.
- .9 Hinge pin: exelloy; bushings: malleable iron.
- .10 Identification tag: fastened to cover.
- .11 Hinge: galvanized malleable iron.

- .12 Swing check valves, NPS 2 1/2 - 8 Class 250:
- .13 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
- .14 Flanged ends: 2 mm raised face with serrated finish.
- .15 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B61.
 - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
- .16 Seat rings: renewable bronze to ASTM B61, screwed into body.
- .17 Hinge pin, bushings: renewable, bronze to ASTM B61.
- .18 Hinge: galvanized malleable iron.
- .19 Identification tag: fastened to cover.

2.7 SILENT CHECK VALVES

- .1 Construction:
- .2 Body: malleable or ductile iron with integral seat.
- .3 Pressure rating: class 125, WP = 860 kPa.
- .4 Connections: grooved ends.
- .5 Disc: bronze stainless steel renewable rotating disc.
- .6 Seat: renewable, EPDM.
- .7 Stainless steel spring, heavy duty.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-2010, Power Piping.
- .2 ASTM International
 - .1 ASTM A125-96(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
- .2 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .3 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
- .4 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .5 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .6 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ASME B31.1.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut.
 - .1 Rod: 9 mm UL listed.

- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP 58 and MSS-SP 69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies
 - .2 Steel brackets
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.2 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.9 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code and authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .7 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.
- .2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.
- .3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 07 15 – Thermal Insulation for Piping.
- .2 Section 25 30 02 – EMCS: Field Control Devices
- .3 Section 26 05 01 - Common Work Results - Electrical.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Provide manufacture's catalog cut sheets showing materials and performance data.
- .3 Provide copy of UL and CSA file listing indicating the heating cable is specifically intended to provide supplementary heating to hot water service supply systems utilizing thermally insulated metal or plastic pipe.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 SELF REGULATING ROOF AND GUTTER TRACING HEATING CABLES

- .1 Supply self-regulating heating cable with 16 AWG copper bus wires, ground braid to be tinned copper, self-regulating polymer core matrix, UV stabilized polyolefin weatherproof outer jacket. Heating capacity: 12W/m in snow or ice at 0°C.
- .2 Accessories: Supply power connection kit, splice kits, and end seal kits as necessary to install as indicated on drawings.
- .3 Electrical: 120V/208V single phase.
- .4 Cables to be ULC listed for snow melting and de-icing equipment.
- .5 Controls:
 - .1 Thermostat: remote bulb type, to Section 25 30 02. Ambient air sensing.

2.2 HOT WATER TEMPERATURE MAINTENANCE CABLES

- .1 The self-regulating heating cable shall consist of two 14 or 16 AWG nickel-plated copper bus wires embedded in a radiation-crosslinked conductive polymer core. It shall be covered by a radiation-crosslinked, polyolefin, dielectric jacket surrounded by a polymer-coated aluminum wrap, and enclosed in a tinned copper braid of 14 AWG equivalent wire size. The braid shall be covered with a 40 mil polyolefin outer jacket, color coded for easy identification.
- .2 Self regulating cable must be designed and specifically approved for maintaining hot water. Cables used for freeze protection of water lines will not be allowed.
- .3 The heater shall operate on a line voltage of 120V/208V without the use of thermostats.
- .4 All heating cable connection kits shall be UL listed, and CSA Certified for use as part of the system to maintain hot water temperature. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating cable core to expose the bus wires. All connection kits except for the power connection shall be installed under the thermal insulation. The end seal shall use silicone gel.
- .5 Installed system shall include at least one agency-approved electronic controller. The controller shall not be of the line sensing over-limit design. The controller shall be capable of setting different pipe temperatures based on ambient and voltage with 24 hour, 7 day/week programmable options. The controller shall have the energy savings feature of lowering pipe temperature during low use periods and the ability to raise the temperature of the pipes for a programmed interval. The controller shall have BAS interface capabilities to set pipe temperatures and provide alarm relays in loss of power, incorrect water temperature and communication failure.
- .6 System shall maintain temperatures between 40°C and 60°C at 120V/208V. Temperature shall be maintained by utilizing an electronic controller with straight runs of heating cable on the pipe.
- .7 The power retention of the heating cable shall be at least 90% after 300 cycles between 10°C and 100°C.
- .8 The heater shall not decrease in resistance, overheat, or burn when powered at 208V and exposed to 205°C in an oven for 30 minutes.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Pipe heat tracing cable:
 - .1 Install heat tracing heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other at any point. Run only cold leads in conduit and ensure sensing bulb does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.
 - .2 Make power and control connections.
- .2 Hot water temperature maintenance cable:

- .1 The system shall be installed according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a functional system, installed in accordance with applicable national and local requirements. Each circuit shall be protected with a 30mA ground-fault protection device.
- .2 Hot water lines shall be pressure tested prior to installation of heating cable and thermal insulation. Thermal insulation shall not be installed until heating cable installation is complete and a megohmmeter test has been passed. Heat-traced hot water lines shall be insulated within two weeks of the heat tracing installation.
- .3 Insulator to comply with minimum nominal insulation sizes as recommended by the manufacturer.
- .4 The insulation shall not be installed with staple. Insulation jackets should be closed with tape or adhesives to avoid damage to the heating cable.
- .5 Heating cables shall be installed to within 3m of fixtures.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Heat Tracing:
 - .1 Use 500 V megger to test cables for continuity and insulation value and record readings before, during and after installation.
 - .2 Where resistance of 50 megohms or less is measured, stop work and advise Departmental Representative.
- .3 Hot Water Temperature Maintenance:
 - .1 Measure the heater circuit continuity and the insulation resistance between the braid and the bus wires with a 2500 Vdc megohmmeter.
 - .2 The tests should be performed at the following stages and shall be witnessed by the Departmental Representative.
 - .1 Prior to installation while the cable is still on the reel(s).
 - .2 After installation of the heating cable and completion of circuit fabrication kits, including splice kits, but prior to installation of thermal insulation.
 - .3 After installation of thermal insulation but prior to installation of wall or ceiling materials.
 - .3 The heater circuit shall be continuous and megohmmeter readings shall be at least 20 megohm regardless of the heater length. Circuits yielding unacceptable readings must be repaired or replaced.
 - .4 Submit records of the test data to the Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing of HVAC.

1.2 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Installation of Sprinkler Systems.
- .2 National Building Code of Canada (NBC) 2010.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Provide system shop drawings complete with performance and product data.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.
 - .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
 - .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
 - .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.
-

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for outdoor installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 SITE VISIT

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Departmental Representative.
- .2 Provide Departmental Representative with notice 24 h in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.

3.3 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93.
- .2 Vibration measurements shall be taken for equipment listed below:
 - .1 Indoor air handling unit;
 - .2 Water cooled condensing units;
 - .3 Condenser water pumps;
- .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.

- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .5 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
 - .2 CAN/CSA-B52-05 (R2009), Mechanical Refrigeration Code
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems.

1.2 SUBMITTALS

- .1 Product Data: submit product data for each item specified.
- .2 Submittals: in accordance with Section 01 33 00.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.3 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .2 Deliver, store and handle in accordance with Section 01 61 00.
 - .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20
 - .2 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
 - .3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.
-

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to be included at a minimum:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity, and equipment tag.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size #5.
 - .2 Equipment in Mechanical Rooms: use size #9.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .3 Main identifier: size #9.
 - .4 Source and Destination identifiers: size #6.
 - .5 Terminal cabinets, control panels: size #5.
 - .6 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .2 Natural gas: to CAN/CSA-B149.1.
 - .3 Refrigerant: to CAN/CSA-B52.
 - .4 Sprinklers: to NFPA 13.
 - .5 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.

- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

- .1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 99 has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative 7 working days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .3 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .4 Application of weatherstripping, sealing, caulking.
 - .5 All pressure, leakage, other tests specified elsewhere in Division 23.
 - .6 All provisions for TAB installed and operational.
 - .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .8 Proper thermal overload protection in place for electrical equipment.
 - .9 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .10 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems, central equipment: plus 5%, minus 5 %.
 - .2 HVAC systems, distribution: plus 10%, minus 5%.
 - .3 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.
- .3 Sample TAB reports for review by Departmental representative.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .2 Details of instruments used.
 - .3 Details of TAB procedures employed.
 - .4 Calculations procedures.
 - .5 Summaries.

1.15 TAB REPORT

- .1 Format to be in accordance with referenced standard.
 - .2 TAB report to show results in SI units and to include:
-

- .1 Detailed tested values at each tested piece of equipment.
- .2 Project record drawings.
- .3 Single line system schematics indicating general routing of duct/piping complete with annotations for outlet number. Outlet number to correspond to outlet number indicated in TAB report. System schematics to include:
 - .1 Dedicated outdoor air system. Include separate schematics for supply distribution and for return/exhaust air distribution.
 - .2 Fancoils and exhaust fans with more than one diffuser
- .3 Submit 2 copies of TAB Report to Departmental Representative for verification and approval, in English, in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 If values within the 30% verification sample are not reproducible as listed in TAB report, bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of TAB standards of AABC and NEBB.
- .2 Do TAB of systems, equipment, components, specified in Division 23.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB and qualified to standards of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

- .7 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .8 At controllers, controlled device.
- .9 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 HYDRONIC SYSTEMS

- .1 Definitions: for purposes of this section, to include low pressure hot water heating, condenser water, glycol systems.
- .2 Standard: TAB to be to most stringent AABC or NEBB.
- .3 Do TAB of systems, equipment, components, controls specified Division 21, 22, 23
- .4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB and qualified to standards of AABC or NEBB.
- .5 Quality assurance: Perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.
- .6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, noise, vibration.
- .7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
- .8 Inlet and outlet of heat exchangers (primary and secondary sides), boiler, coil, humidifier, fluid cooler, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
- .9 At controllers, controlled device.
- .10 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of primary and secondary loops (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.21 OTHER SYSTEMS

- .1 Plumbing systems:
- .2 TAB procedures:
 - .1 Flush valves: adjust to suit project pressure conditions.
 - .2 Pumped sanitary systems: test for proper operation at all possible flow rates.

1.22 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:

- .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter design conditions.
- .3 TAB procedures:
 - .1 Balance all supply air outlets to design conditions
 - .2 Balance all exhaust air outlets to design conditions
 - .3 Balance return air outlets as specified on drawings or to ensure supply air is 10% larger than the sum of exhaust air and return air, whichever is less.

1.23 POST- OCCUPANCY TAB

- .1 Measure DBT, WBT (or %RH), NC levels, in occupied zone of following areas:
 - .1 National Parole Board Room P111
 - .2 Warden's Office P210
 - .3 Assistant Warden P203
 - .4 Meeting Room P208
 - .5 Open Workstations P201
 - .6 Chief of Finance P213
 - .7 Security Intel Officer P227.
 - .8 Meeting Room P220
 - .9 Private Visit P125
 - .10 PE Office P106
 - .11 Visitation and Correspondence Area P127
- .2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

- .1 Ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment to be pressure tested for leaks.

1.2 TIMING

- .1 Ducts to be tested before installation of insulation or any other form of concealments.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.3 EXCLUSIONS

- .1 Flexible connections to terminal boxes.

1.4 REFERENCES

- .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.5 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested to be consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on Reference Standard.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

1.6 TESTING AGENCY

- .1 Installing Contractor.

1.7 VERIFICATION

- .1 Departmental Representative to witness tests and to verify reported results.
- .2 To be certified by the same TAB agency approved by Departmental Representative to undertake TAB on this project.

1.8 TEST INSTRUMENTS

- .1 Testing agency to provide instruments for tests.
 - .2 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
-

- .3 Flow measuring instrument compatible with the orifice plate.
- .4 Calibration curves for orifice plates used.
- .5 Flexible duct for connecting to ductwork under test.
- .6 Smoke bombs for visual inspections.
- .3 Test apparatus to be accurate to within +/- 3 % of flow rate and pressure.
- .4 Submit details of test instruments to be used to Departmental Representative at least one month before anticipated start date.
- .5 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 3 months before start of tests.
- .6 Instruments to be re-calibrated every six months thereafter.

1.9 SYSTEM LEAKAGE TOLERANCES

- .1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: Leakage 2 %.
 - .2 Terminal box and duct on downstream side of terminal box: Leakage 2 %.
 - .3 Large low pressure duct systems up to 500 Pa: Leakage 2 %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

1.10 REPORT FORMS

- .1 Submit proposed report form and test report format to Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.

1.11 PRESSURE TEST REPORTS

- .1 Prepare report of results and submit to Departmental Representative within 7 days of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
- .2 Include test reports in final TAB report.

Part 2 PRODUCTS

2.1 **NOT USED**

.1 Not Used.

Part 3 **EXECUTION**

3.1 **NOT USED**

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.

- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Shop Drawings:
 - .1 Submit shop drawings for each insulation type proposed for the project.
- .4 Samples:
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations and special handling criteria, installation sequence, cleaning procedures.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, and a member of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
- .2 Maximum flame spread rating: 25.
- .3 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .2 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .3 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:
 - .1 220gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
 - .1 Maximum VOC limit 200 g/L to SCAQMD Rule 1168.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit 170 g/L to SCAQMD Rule 1168.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, untreated.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting

- .1 Maximum VOC limit 200 g/L to SCAQMD Rule 1168.
- .8 Canvas adhesive: washable.
- .1 Maximum VOC limit 200 g/L to SCAQMD Rule 1168.
- .9 Tie wire: 1.5mm stainless steel.
- .10 Banding: 19mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and	C-2	yes	50

dual temperature supply air ducts Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Acoustically <u>lined ducts</u>	none		

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1992, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations

- .1 Thermal Insulation Association of Canada (TIAC): Mechanical Insulation Best Practice Guide (Revised 2005).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 ULC-S702.2-10, Standard for Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 RELATED SECTIONS

- .1 Section 07 92 00 – Joint Sealants
- .2 Section 22 11 16 – Domestic Water Piping
- .3 Section 23 05 33 – Heat Tracing for HVAC Piping and Tanks
- .4 Section 23 23 00 – Copper Tubing and Fittings Refrigerant
- .5 Section 23 81 40 – Air and Water Source Heat Pumps

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
 - .1 Submit one copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00.

- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00.
 - .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.
 - .2 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, member of TIAC.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .2 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.
 - .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .4 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
- .2 Maximum flame spread rating: 25
- .3 Maximum smoke developed rating: 50

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
 - .2 Maximum "k" factor: 0.035 W/m°C; to CAN/ULC-S702 and ASTM C547.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: 0.035 W/m°C ; to CAN/ULC-S702 and ASTM C547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: 0.035 W/m°C ; to CAN/ULC-S702 and ASTM C547.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: 0.04 W/m°C.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.5 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.7 JACKETS

- .1 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: compatible with insulation.
- .2 Aluminum:
 - .1 To ASTM B209M.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.8 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 00.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.

- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at valves, flanges and unions at equipment.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements: tape.
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: SS bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temperature	TIAC	Pipe sizes (NPS) and insulation thickness (mm)
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	(°C)	Code	Run-out	to 1	1 to 1 ½	2 to < 4	4 to < 8	8 and up
Hot Water Heating	60-94	A-1	25	38	2	2	2	2
Domestic Hot Water Supply	Up to 60	A-1	25	25	38	50	50	50
Condenser Water – Outdoor	All temperatures		25	25	25	38	38	38
Condenser Water - Indoor	All temperatures		25	25	25	25	25	25
Domestic Cold Water Supply		A-3	15	25	25	25	25	25
Refrigerant Piping – High and Low Pressure Gas		A-6	15	15	25	25	25	25
Refrigerant Piping – Liquid		A-6	15	15	25	25	25	38
Rain Water Leader		C-2	25	25	25	25	25	25

.7 Finishes:

- .1 Exposed indoors: canvas.
- .2 Exposed in mechanical rooms: canvas.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: water-proof aluminum jacket.
- .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Section 22 42 01 - Plumbing Specialities and Accessories.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 ASTM E202-09, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Timing:
 - .1 After cleaning is completed and system is in full operation.
 - .2 When systems are operational, perform following tests:
- .2 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
- .3 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Maximum cooling demand.
 - .7 Boiler failure.
 - .8 Dry cooler fan failure.
 - .9 Outdoor reset. Re-check output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 HYDRONIC SYSTEM CAPACITY TEST

- .1 Timing: After:
 - .2 TAB has been completed
 - .3 Verification of operating, limit, safety controls.
 - .4 Verification of primary and secondary pump flow rates.
-

- .1 Verification of accuracy of temperature and pressure sensors and gauges.
- .5 Calculate system capacity at test conditions.
- .6 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .7 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .8 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .9 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
 - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures at all times to ensure that coils are not subjected to freezing conditions) or
 - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .10 Test procedures:
 - .1 Open fully, heating coil control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.6 GLYCOL SYSTEMS

- .1 Test to prove concentration will prevent freezing to minus 20°C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.7 GASEOUS FUEL SYSTEMS

- .1 Operation tests:
 - .1 Measure gas pressure at gas meter outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
 - .4 Check terminals of vents for gas pressure regulators.

1.8 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
- .2 Verify performance of equipment and systems as specified elsewhere in Division 23.
- .3 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
- .4 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

1.9 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 21.
- .2 Verification of controls, detection devices, alarm devices is specified Electrical Divisions.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, obstructions, etc.
- .4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.10 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: Refer to Section 22 42 01.
- .6 Roof drains:
 - .1 Refer to Section 22 42 01.
 - .2 Remove caps as required.

1.11 REPORTS

- .1 In accordance with Section 01 91 00: Reports, supplemented as specified herein.

1.12 TRAINING

- .1 In accordance with Section 01 91 00: Training of O&M Personnel

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 25 00 - HVAC Water Treatment Systems.
- .2 Section 23 05 93 - Testing Adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 American Society for Testing and Materials
 - .1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.
- .3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 EXECUTION

3.1 CLEANING HYDRONIC SYSTEMS

- .1 Timing:
 - .1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
 - .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
 - .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
-

- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations to be used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water to be used to ensure water will not damage systems or equipment.
 - .5 Conditions at time of cleaning of systems
 - .1 Systems to be free from construction debris, dirt and other foreign material.
 - .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers to be clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.
 - .6 Report on Completion of Cleaning
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
 - .7 Hydronic Systems:
 - .1 Fill system with water, ensure air is vented from system.
 - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
 - .3 Use water metre to record volume of water in system to +/- 0.5%.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.
 - .5 Closed loop systems: circulate system cleaner at 60° C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
 - .6 Flush velocity in system mains and branches so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .7 Add chemical solution to system.
 - .8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38° C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
 - .8 Glycol Systems:
 - .1 In addition to procedures specified above perform procedures specified herein.
-

- .2 Test to prove concentration will prevent freezing to minus 20° C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

3.2 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Commission water treatment systems as specified in Section 23 25 00.
 - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .8 Repeat with water at design temperature.
 - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .10 Bring system up to design temperature and pressure slowly.
 - .11 Perform TAB as specified in Section 23 05 93.
 - .12 Adjust pipe supports, hangers, springs as necessary.
 - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
 - .15 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .16 Check operation of drain valves.
 - .17 Adjust valve stem packings as systems settle down.
 - .18 Fully open all balancing valves (except those that are factory-set).
 - .19 Check operation of over-temperature protection devices on circulating pumps.
 - .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 01 - Installation of Pipework.
- .2 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
 - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ANSI/ASME B18.2.1-2010, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
- .2 ASTM International
 - .1 ASTM A47/A47M-99(R2009), Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B32-08, Specification for Solder Metal.
 - .4 ASTM B75M-99(R2011), Specification for Seamless Copper Tube Metric.
- .3 Canadian Standards Association (CSA)
 - .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
 - .2 CAN/CSA-B149.1-10, Natural Gas Installation Code.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate on manufacturers catalogue literature following: valves.

1.4 CLOSEOUT SUBMITTALS

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
 - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .3 Fold up metal banding, flatten and place in designated area for recycling.
-

Part 2 PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B75M.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Soldered: to ASTM B32-08, tin antimony 5/5.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ANSI/ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ANSI/ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ANSI/ASME B16.18.
 - .2 Wrought copper fittings: to ANSI/ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated plug type.

Part 3 EXECUTION

3.1 PIPING

- .1 Install in accordance with Section 23 05 01, supplemented as specified herein.
 - .2 Install in accordance with applicable National Building Code.
 - .3 Install in accordance with CAN/CSA B149.1.
 - .4 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.
-

3.2 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.4 PURGING

- .1 Purge after pressure test in accordance with CAN/CSA B149.1.

3.5 PRE-START-UP INSPECTIONS

- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING AND START-UP

- .1 In accordance with Section 23 08 02, supplemented as specified herein.
- .2 In accordance with requirements of CAN/CSA B149.1

3.7 PERFORMANCE VERIFICATION (P.V.)

- .1 Refer to Section 23 08 01.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 05 – Installation of Pipework.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9-07, Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
 - .6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
 - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - .1 MSS-SP-67-2002a, Butterfly Valves.
 - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.

- .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
- .1 Include special servicing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect hydronic systems 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 Waste Reduction Workplan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
- .1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Roll grooved: standard coupling to CSA B242.
- .4 Flanges: plain, slip-on to ANSI/AWWA C111/ A21.11.
- .5 Orifice flanges: slip-on raised face, 2100 kPa.

- .6 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .7 Pipe thread: taper.
- .8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .9 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- .5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M ductile iron to ASTM A536.

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged or grooved ends.
- .2 Gate valves: to MSS-SP-70 or MSS-SP-80 application: isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, wedge disc, as specified Section 23 05 23.01.
 - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Mechanical Rooms: rising stem, wedge disc, lead free bronze trim, as specified Section 23 05 23.02.
 - .1 Operators: chain or manual.
 - .2 Elsewhere: non-rising stem, solid wedge disc, lead free bronze trim, as specified Section 23 05 23.02.
 - .1 Operators: chain or manual.
- .3 Butterfly valves: to MSS-SP-67 application: isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2-1/2 and over: grooved ends: as specified Section 23 05 17.
- .4 Globe valves: to MSS-SP- 80 application: throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01.

- .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01.
- .2 NPS 2-1/2 and over:
 - .1 With composition lead free bronze disc, lead free bronze trim, as specified Section 23 05 23.02.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.
- .7 Swing check valves: to MSS-SP-71.
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged or grooved ends: as specified Section 23 05 23.02.
- .8 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged or grooved ends: as specified Section 23 05 23.02.
- .9 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems 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.

3.2 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05.

3.3 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.

3.4 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02.

3.5 TESTING

- .1 Test system in accordance with Section 21 05 01.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.6 BALANCING

- .1 In accordance with Section 23 05 93 for applicable procedures.

3.7 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-04(2007), Boiler and Pressure Vessel Code.
- .2 ASTM International Inc.
 - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Expansion Tanks
 - .2 Strainers
 - .3 Air separators
 - .4 Suction Diffusers
 - .5 Air vents
 - .6 Pressure reducing valves

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and operation data in accordance with Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
-

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical steel pressurized diaphragm type expansion tank.
- .2 Capacity: as per mechanical schedules.
- .3 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.
- .4 Working pressure: 520 kPa.
- .5 Air precharged to 140 kPa (initial fill pressure of system).
- .6 Base mount for vertical installation.

2.2 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.
- .2 Float: solid material suitable for 115 degrees C working temperature

2.3 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860 kPa.
- .2 Size: 100mm.

2.4 COMBINATION SEPARATORS/STRAINER S

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.5 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206 kPa relief, 551 to 140 kPa reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.6 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
 - .2 NPS 2 1/2 to 12: cast iron body to ASTM A278/A278M, Class 30 flanged connections.
 - .3 Blowdown connection: NPS 1
 - .4 Screen: stainless steel with 1.19 mm perforations.
 - .5 Working pressure: 860 kPa.
-

2.7 SUCTION DIFFUSER

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tapings.
- .6 Adjustable support leg.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .4 Check shop drawings for conformance of tapings for ancillaries and for equipment operating weights.

3.3 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.4 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.

3.6 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.
-

3.7 SUCTION DIFFUSERS

- .1 Install on inlet to pumps having suction size greater than 50.

3.8 PERFORMANCE VERIFICATION

- .1 Operational requirements in accordance with Section 01 79 00, include:
 - .1 Repair and maintenance materials and instructions.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC)
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1-2006, Motors and Generators.

1.2 RELATED SECTIONS

- .1 Section 23 05 53.01 – Mechanical Identification
- .2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- .3 Section 25 90 01 – Site Requirements, Applications and Systems Sequences of Operation

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Provide shop drawings indicating the following:
 - .1 Casing construction
 - .2 Pump curves with operating point indicated
 - .3 Impeller size and construction
 - .4 Electrical requirements
 - .5 Variable speed drives
 - .4 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE

- .1 Provide maintenance materials in accordance with Section 01 78 00.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 IN-LINE CIRCULATORS

- .1 Pump to be maintenance free design and capable of operating in variable speed applications. Pump to be designed for quiet operation.
- .2 Volute: cast iron with flanged design suction and discharge connections.
- .3 Impeller: Non-metallic
- .4 Shaft: alloy steel with permanently lubricated sealed precision bearings. Bearings to be permanently oil lubricated.
- .5 Seal assembly: mechanical for service to 107°C. Seal to be carbon/silicone assembly
- .6 Coupling: rigid
- .7 Motor: resilient mounted, drip proof, non-overloading at any point on the pump curve. CSA and UL listed.
- .8 Capacity: as indicated.
- .9 Design pressure: 1034 kPa.

2.2 VERTICAL IN-LINE CIRCULATORS

- .1 Volute: cast iron, vertically split, with tapped openings for venting, draining and gauge connections, with flanged suction and discharge connections.
 - .2 Impeller: Brass impeller to be hydraulically and dynamically balanced, keyed to the shaft and secured by a locking cap screw or nut.
 - .3 Shaft: alloy steel with non-ferrous shaft sleeve to completely cover the wetted area under the seal.
 - .4 Seal assembly: mechanical for service to 107°C. Seal assembly shall have a brass housing, stainless steel spring and carbon ceramic design with the carbon face rotating against a stationary ceramic face
 - .5 Coupling: rigid self-aligning.
 - .6 Motor: Motors shall have heavy-duty grease lubricated ball bearings. Motors shall be non-overloading at any point along the pump curve. Motor to be suitable for variable speed operation.
-

- .7 Capacity: as indicated.
- .8 Design pressure: 1200 kPa.

2.3 VARIABLE SPEED DRIVES

- .1 Provide variable speed drives for pumps as indicated on mechanical schedules.
- .2 Variable speed drive to be provided by pump manufacturer and suitable of operating with pump at selected performance rating.
- .3 Variable speed drive shall be specifically designed for variable speed pumping applications.
- .4 Controller shall have programs to safeguard against the following damaging hydraulic conditions including:
 - .1 Pump flow surges
 - .2 Hunting
 - .3 System over pressure
- .5 Controller shall be capable of receiving up to four analog inputs from zone sensors or transmitters, and select the sensor that has deviated the greatest amount from its setpoint. The selected signal will be used as the command feedback input for the hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different setpoint value.
- .6 Controller shall be capable of controlling and sequencing up to four pumps in parallel.
- .7 The hydraulic stabilization program shall utilize a proportional-integral-derivative (PID) control function . The PID values shall be user adjustable over an infinite range.
- .8 The pump logic controller shall be self prompting. The operator interface shall have the following features:
 - .1 Multi-fault memory and recall last 10 faults and related operational data.
 - .2 Red fault light, yellow warning light, green power on light
 - .3 Soft-touch membrane keypad switches.
 - .4 Display shall have four lines, with 20 characters on three lines and eight large characters on one line.
 - .5 Actual pump information shall be displayed indicating pump status
- .9 The following hardwire communication features shall be provided to the BAS:
 - .1 Remote system start/stop non-powered digital input
 - .2 Failure of any system component. Output closes to indicate alarm condition.
 - .3 One 4-20ma output with selectable output of
 - .1 Frequency
 - .2 Process Variable
 - .3 Output Current
 - .4 Output Power
- .10 Variable speed drive shall be capable of communicating with BAS over BACnet protocol.

- .11 Variable speed programmable logic to be held in EEPROM storage to prevent accidental loss of data due to voltage surge or spike.
- .12 Refer to Section 25 90 01 for sequence of operation.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install hydronic pumps to: CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

3.3 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 00: General Requirements; supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.
 - .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 3 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
-

- .8 Adjust water flow rate through water-cooled bearings.
- .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .10 Adjust alignment of piping and conduit to ensure true flexibility.
- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.4 PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 Verify performance in accordance with Section 01 91 00: General Requirements, supplemented as specified herein.
- .2 Verify that manufacturer's performance curves are accurate.
- .3 Ensure valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in Section 01 91 00.
 - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: in accordance with Section 01 91 00 reports supplemented as specified herein. Reports to include:
 - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Use Report Forms specified in Section 01 91 00: Report Forms and Schematics.
 - .3 Pump performance curves (family of curves).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 01 - Installation of Pipework.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ANSI/ASME B16.24-2011, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ANSI/ASME B16.26-2011, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ANSI/ASME B31.5-2010, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
 - .1 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B280-08, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B52-05(R2009), Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
- .5 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121°C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 45% Ag-15% Cu 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 A307, heavy series.
- .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

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

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof 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, moistureproof seal for below freezing applications, brazed connections.
- .3 Isolation Valves:
 - .1 Class 650, 4.48 MPa, ball valve, forged brass body, compatible with HCFC and HFC refrigerants, full flow design, 100% copper extended connections, operating range -40°C – 120°C.

Part 3 EXECUTION

3.1 GENERAL

- .1 In accordance with Section 23 05 01, supplemented as specified herein
- .2 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

3.2 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.

3.3 PIPING INSTALLATION

- .1 General:
 - .2 Soft annealed copper tubing: bend without crimping or constriction
 - .3 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 above.
 - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.4 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND CHARGING

- .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa 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 14Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14kPa.
 - .3 Final to 5Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental 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 Departmental Representative.

3.6 INSTRUCTIONS

- .1 Post instructions in frame with glass cover in accordance with Section 01 78 01 and CSA B52.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, Section VII-2010.
- .2 American Society for Testing and Materials
 - .1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Include following:
 - .1 Log sheets as recommended by manufacturer.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Unused metal and wiring materials are to be diverted from landfill to a metal recycling facility as approved by the Departmental Representative.
- .2 Dispose of unused water treatment chemicals at official hazardous material collections site approved by Departmental Representative.
- .3 Do not dispose of unused water treatment chemicals into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 MANUFACTURER

- .1 Equipment, chemicals, service by one supplier.

2.2 WATER TREATMENT FOR HYDRONIC SYSTEMS

- .1 Packaged Glycol Feed System:
 - .1 Provide polyethylene glycol feed tank, 19L, operating pressure 1035 kPa.
 - .2 Tank to have rotary positive displacement pump for charging glycol system.
-

- .3 Glycol addition controlled by a pressure switch with adjustable low and high set points.
 - .4 Float switch for low level pump shutoff and alarm
 - .5 Power cord with plug, 120V
 - .6 Control panel with the following:
 - .1 Integral transformer for 120V/24V.
 - .2 Hand-Off-Auto
 - .3 Pump “on” indicator light
 - .4 Dry contact for remote low level indication to BAS
 - .5 Audible alarm and push button silence.
 - .7 System to be filled with pre-engineered inhibited glycol. Mixture to be 40% propylene glycol.
- .2 Micron filter:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.3 TEST EQUIPMENT

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CLEANING OF MECHANICAL SYSTEM

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.
 - .2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
 - .3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
 - .4 Drain and flush system until alkalinity of rinse water is equal to make-up water.
 - .5 Disposal of cleaning solutions to be approved by authority having jurisdiction.
-

3.3 WATER TREATMENT SERVICES

- .1 Provide the following water treatment services:
 - .1 Initial water analysis and treatment recommendations.
 - .2 System start-up assistance.
 - .3 Operating staff training.
 - .4 Provide necessary recording charts and log sheets for one year operation.

3.4 START-UP

- .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Retest for glycol concentration to ASTM E202 after cleaning and system fill.

3.5 COMMISSIONING

- .1 Commissioning Agency: To be Water treatment supplier.
 - .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After start-up and before TAB of connected systems.
 - .3 Pre-commissioning Inspections:
 - .1 Verify:
 - .1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
 - .2 Suitability of log book.
 - .3 Currency and accuracy of raw water analysis.
 - .4 Required quality of treated water.
 - .4 Commissioning procedures - applicable to Water Treatment Systems:
 - .1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.
 - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
 - .3 Establish test intervals, regeneration intervals.
 - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
 - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
 - .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
 - .7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.
 - .5 Commissioning procedures - Closed Circuit Hydronic Systems:
 - .1 Analyse water in system.
-

- .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
- .3 Record types, quantities of chemicals applied.
- .6 Training:
 - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
 - .2 Train O&M personnel in softener regeneration procedures.
- .7 Certificates:
 - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .8 Commissioning Reports:
 - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.
- .9 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

- .1 Section 07 84 00 - Firestopping.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .3 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .2 ASTM International.
 - .1 ASTM A480/A480M-11b, 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, Carbon, Hot Rolled.
 - .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 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
 - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .5 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-2011, 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, 3rd Edition 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
 - .3 SMACNA IAQ Guidelines for Occupied Buildings Under Construction 2nd edition 2007; ANSI/SMACNA 008-2008.
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- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
 - .1 Sealants.
 - .2 Tape.
 - .3 Proprietary Joints.

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .2 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .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 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa SMACNA Seal Class

500	C
250	C
125	C
125	Unsealed

- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
 - .2 Unsealed seams and joints.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Rectangular: Centreline radius: 1.0 times width of duct.
 - .2 Round: Centreline radius: 1.0 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Short radiused elbows.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00.
-

- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating, minimum 30% recycled content.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA

2.8 STAINLESS STEEL

- .1 To ASTM A480/A480M, Type 304, minimum 75% recycled content.
- .2 Finish: No. 4
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA.

2.9 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29.
- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
- .1 Maximum size duct supported by strap hanger: 500.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to following table:

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
<u>2401 and over</u>	<u>50 x 50 x 6</u>	<u>10</u>

- .2 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
- .2 For steel joist: manufactured joist clamp.
- .3 For steel beams: manufactured beam clamps:

Part 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, SMACNA and as indicated on drawings.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .1 Insulate strap hangers 100 mm beyond insulated duct.

- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining where acoustic lining is indicated.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with as follows:

<u>Duct Size</u> (mm)	<u>Spacing</u> (mm)
to 1500	3000
1501 and over	2500

3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.4 LEAKAGE TESTS

- .1 Refer to Section 23 05 94.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 20 m long with not less than three branch takeoffs and one 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

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

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 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°C to plus 90°C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
-

- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.
 - .2 301 to 450 mm: four sash locks.
 - .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.

2.4 TURNING VANES

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

2.5 INSTRUMENT TEST

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

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

Part 3 EXECUTION

3.1 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:

- .1 600 x 600 mm for person size entry.
- .2 200 x 200 mm for servicing entry.
- .3 150 x 200 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 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.
 - .2 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.
 - .3 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental 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.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

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

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20, and with the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single 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.

2.3 SINGLE BLADE DAMPERS

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

2.4 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.

- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Ensure damper operators are observable and accessible.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112-10, Standard Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .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.

1.3 CLOSEOUT SUBMITTALS

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

1.4 EXTRA MATERIALS

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

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20, and with the Waste Reduction Workplan.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
-

Part 2 PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, and bear label of ULC, meet requirements of Fire Commissioner of Canada (FCC) and NFPA 90A. Fire damper assemblies to be 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.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame installed as per manufacture's listing.

2.2 FIRE STOP FLAPS

- .1 To be 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 to be held open with fusible link conforming to ULC-S505 and close at 74°C.

Part 3 EXECUTION

3.1 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.
- .5 Coordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-2012, Installation of Warm Air Heating and Air Conditioning Systems.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-07, Fire Tests for Air Ducts.
 - .2 UL 181-2005, Factory Made Air Ducts and Connectors.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SAMPLES

- .1 Submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
 - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .3 Fold up metal banding, flatten and place in designated area for recycling.
-

Part 2 PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

- .1 Type 3: non-collapsible, coated aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

Part 3 EXECUTION

3.1 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C177-10, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
 - .2 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.
- .3 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.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97).
- .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.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

Part 2 PRODUCTS

2.1 DUCT LINER

- .1 General:
 - .1 Fibrous glass duct liner: air stream side faced with 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.
-

- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25 mm thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
 - .3 Density: 36 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.76 m².°C/W for 25 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.
- .3 Flexible:
 - .1 Use on round or oval surfaces.
 - .2 25 mm thick, to CGSB-51-GP-11M, fibrous glass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.74 m².°C/W for 25 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.

2.2 ADHESIVE

- .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 29°C to plus 93°C.

2.3 FASTENERS

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

2.4 JOINT TAPE

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

2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.

Part 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:

- .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 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 two coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .3 Section 23 05 53.01 – Mechanical Identification
- .4 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

- .1 Air Movement and Control Association (AMCA)
 - .1 AMCA 99-10, Standards Handbook.
 - .2 ANSI/AMCA 210-07/ANSI/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - .3 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 CAN/CGSB-1.181-99, Coating, Zinc Rich, Organic, Ready Mixed.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Provide :
 - .1 Fan performance curves showing point of operation, kW, and efficiency.
 - .2 Sound rating data at point of operation.
- .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Supplied accessories.

1.4 CLOSEOUT SUBMITTALS

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

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish 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.
-

1.6 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

Part 2 PRODUCTS

2.1 FANS GENERAL

- .1 Capacity: flow rate, static pressure, W, efficiency, revolutions per minute, power, sound power data and as indicated on schedule.
- .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with ANSI/AMCA 301, tested to ANSI/AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210/ANSI/ASHRAE 51.
- .5 Motors:
 - .1 In accordance with Section 23 05 13 supplemented as specified herein.
 - .2 Sizes as specified on mechanical schedules.
 - .3 Permanently lubricated and matched to fan loads. Motor shall be readily accessible for maintenance.
- .6 Accessories and hardware: NEMA-1 disconnect switch.
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .9 Vibration isolation: to Section 23 05 48.
- .10 Flexible connections: to Section 23 33 00.

2.2 INLINE CENTRIFUGAL FANS

- .1 .1 Fan wheels:
 - .2 Welded aluminum construction.
 - .3 Backward inclined blades, as indicated.
 - .4 Complete with wheel cone matched to inlet cone.
 - .5 Fans to be direct drive.
 - .2 Housings:
 - .1 Volute with inlet cones: aluminum, for smaller wheels, braced, and with welded supports.
 - .2 Square heavy gauge galvanized steel or aluminum construction. Housing to include square inlet and outlet collars
 - .3 Two removable access panels or sufficient size to access and service all components.
-

Part 3 EXECUTION

3.1 FAN INSTALLATION

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 25 30 01 – Building Controllers
- .2 Section 25 90 01 – Site Requirements, Applications, and Systems Sequences of Operation

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 51-2007/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Installation of Air Conditioning and Ventilating Systems.
- .3 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.
- .4 Underwriter's Laboratories (UL)
- .5 UL 181-2005, Factory-Made Air Ducts and Air Connectors.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Size and Dimensions
 - .5 Reheat Coil.

1.4 CLOSEOUT SUBMITTALS

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

1.5 CERTIFICATION

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.

- .2 Furnish 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.

Part 2 PRODUCTS

2.1 MANUFACTURED UNITS

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

2.2 CONSTANT VOLUME BYPASS BOXES

- .1 Maintains space condition by bypassing supply air to return air.
- .2 Sizes, capacities, pressure loss, reheat capacity: as indicated.
- .3 Complete with:
 - .1 Bypass collar for connection to return air duct.
 - .2 Minimum air volume stop.
 - .3 Controller and operator
 - .4 Reheat coil as indicated.
 - .5 Manual balancing damper on inlet and outlet
- .4 Casing: constructed of 22 gauge thick galvanized steel, internally lined with 15 mm acoustic insulation to UL 181 and NFPA 90A. Mount control components inside protective metal shroud.
- .5 Damper: galvanized 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.
- .6 Factory mount terminal controller provided by controls contractor. Refer to Section 25 30 01.
- .7 Provide with modulating electronic control package. Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .8 Sequence of, operation as specified under Section 25 90 01.
- .9 Include 1-row hot water heating coil of performance indicated in mechanical schedules. A quick opening access panel shall be provided to allow cleaning and inspection of the coil.
- .10 Coils to be constructed of 15mm copper tube. Fins to be galvanized steel. Coils shall be pressure tested coils at 2482 kPa and certified to AHRI 410.

Part 3 EXECUTION

3.1 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 so that controls, dampers and access panels are easily accessible.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Door grilles: Section 08 90 00 - Louvres and Vents.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
 - .6 Size.
 - .7 Finish and Colour.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Samples are required for following:
 - .1 E-1.
 - .2 S-2.
 - .3 S-4.

1.4 CERTIFICATIONS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.
-

Part 2 PRODUCTS

2.1 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 at all locations and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators where indicated.
- .4 Colour: as indicated on mechanical schedules.

2.2 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Type S-3: as indicated on mechanical schedules

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 Type R-1: type as indicated on mechanical schedules.
- .2 Type R-2: type as indicated on mechanical schedules.
- .3 Type E-1: type as indicated on mechanical schedules.

2.5 DIFFUSERS

- .1 General: volume control dampers with flow straightening devices and gaskets.
- .2 Type S-1: type as indicated on mechanical schedules.
- .3 Type S-2: type as indicated on mechanical schedules.
- .4 Type S-5: type as indicated on mechanical schedules.
- .5 Type S-6: type as indicated on mechanical schedules.
- .6 Type S-7: Type as indicated on mechanical schedules. Temperature sensors to be provided by Division 25.

2.6 LINEAR GRILLES

- .1 Type S-4: as indicated on mechanical schedules

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
- .2 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.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
 - .1 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Size and finish.
 - .4 Mounting arrangement.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Test Reports:
 - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .2 Deliver, store and handle in accordance with Section 01 61 00.
 - .3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

Part 2 PRODUCTS

2.1 FIXED LOUVRES – ALUMINUM – LVR-1

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy AA 6063-T5.
- .3 Blade: 6063-T5 extruded aluminum, 2mm minimum thickness, with reinforced boxes. K-style. Maximum blade length of 1500 mm. Space blades 150mm on centre.
- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 2 mm thick with caulking slot integral to unit.
- .5 Mullions: Concealed type allowing continuous line appearance.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 19 mm mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: Power coat matte finish. Colour: Custom. Mechanical contractor to request existing wall from Departmental representative for colour matching.

2.2 FIXED LOUVRES – ALUMINUM – LVR-2

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy AA 6063-T5.
- .3 Blade: 6063-T5 extruded aluminum, 2mm minimum thickness, with reinforced boxes. K-style. Maximum blade length of 1500 mm. Space blades 150mm on centre.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 2 mm thick with caulking slot integral to unit.
- .5 Mullions: Concealed type allowing continuous line appearance.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

- .7 Screen: 19 mm mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: Power coat matte finish. Colour: Custom. Mechanical contractor to request Aluminum Composite Material wall sample from Departmental representative for colour matching.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.
- .4 Patch around openings made in existing structure. Repair existing siding and paint to match existing colour.

3.3 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .2 Section 23 11 23 – Facility Natural Gas Piping
- .3 Section 25 90 01 – Site Requirements, Applications and System Sequences of Operation

1.2 REFERENCES

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI)
 - .1 ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .3 American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2010.
- .4 Canadian Gas Association (CGA)
 - .1 CAN1-3.1-77(R2006), Industrial and Commercial Gas-Fired Package Boilers.
- .5 Canadian Standards Association (CSA)
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .7 Government of Canada
 - .1 CCD-012: Hot water heating boiler – gas-fired condensing.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Indicate the following:
 - .1 General arrangement showing terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings and wiring diagrams.
 - .6 Burners.
 - .7 Boiler controls
 - .8 All miscellaneous equipment.
 - .9 Boiler safety devices.
 - .10 Breeching and stack configuration complete with certification.
 - .11 Condensate neutralization kit.
-

- .12 Low-loss Header.
- .3 Engineering data to include:
 - .1 AFUE efficiency rating.
 - .2 Efficiency versus return water temperature and firing rate curves
 - .3 Boiler pressure drop versus water flow rate curve.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
- .4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.6 MAINTENANCE

- .1 Maintenance materials to include:
 - .1 Special tools for burners, manholes, handholes and Operation and Maintenance.
 - .2 Spare burner tips.
 - .3 Spare burner gun.
 - .4 Safety valve test gauge.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Packaged gas-fired hot water condensing heating boiler:
 - .1 Complete with burner and necessary accessories and controls.
 - .2 Stainless steel heat exchanger.
 - .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
 - .4 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.
 - .5 Boiler shall be CSA Approved and build in compliance with ASME Section IV.
 - .6 Boiler shall be certified by CCD-012.
 - .7 Rated for zero clearance to combustibles.
-

- .2 Performance:
 - .1 In accordance with American Boiler Manufacturers Association (ABMA), or ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
 - .2 Efficiency and turn-down ratio as per mechanical schedules.
- .3 Mounting:
 - .1 Wall mounted.
- .4 Start-up, instruction, on-site performance tests: 3 days.
- .5 Trial usage:
 - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
 - .2 Supply labour, materials and instruments required for tests.
- .6 Temporary use by contractor:
 - .1 Contractor may use boilers only after written approval from Departmental Representative.
 - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
 - .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 MODULAR HOT WATER BOILER, NATURAL GAS FIRED, CONDENSING TYPE

- .1 Factory-assemble each module to include combustion air inlet chamber, pre-purge blower assembly, air-gas fuel control valve, cast pulse combustion chamber, welded absorption chamber with spiralled fire tubes and exhaust chamber. Assembly to be housed in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights. Provide coupling on combustion air inlet and exhaust chambers for connections of venting and combustion air materials. Complete with condensate drain connection. Boiler materials will enable operation with flue gas temperature below dewpoint without corrosion.
 - .2 Single stainless steel heat exchanger.
 - .3 Venting and Combustion Air:
 - .1 Boiler venting and combustion air equipment to be manufactured from stainless steel.
 - .2 Each boiler to be individually direct vented. Boiler venting to be factory certified and ULC listed.
 - .3 Boilers to be capable of sealed combustion air drawn directly from outdoors.
 - .4 Burner:
 - .1 Burner to be constructed from high-grade stainless steel, suitable for use with either natural gas or propane.
 - .2 Ignition shall be by direct spark ignition.
 - .3 Burner to be controlled from boilers control interface.
 - .4 Capable of operating up to 3,000m without change to orifices.
-

- .5 Control system:
 - .1 Designed and provided for heating boiler by manufacturer.
 - .2 The controller shall communicate a modulating boiler temperature set point to the individual boilers, and shall be weather responsive reset-based.
 - .3 The control shall be able to communicate with up to 4 boilers, and allow for outdoor air temperature sensor input. The control shall utilize an infinitely adjustable heating curve to calculate the supply temperature.
 - .4 Include a fused output for dedicated boiler pump connection.
 - .5 Capable of communication with building automation system at a minimum the following parameters. Communication protocol shall be BACnet.
 - .1 Boiler Status
 - .2 Boiler remote Enable/Disable
 - .3 Boiler Supply Temperature Setpoint
 - .4 Boiler Alarm Condition
 - .6 System shall have an auto rotation sequence for the boilers.
 - .7 System shall have an hour and pulse counter for individual boiler operation.
- .6 Control Interface:
 - .1 Visual indicator for system faults
 - .2 Multiple level access system programming and information retrieval
 - .3 Visual indicator for current boiler enabled.
 - .4 Display of current boiler water temperature
 - .5 Display of current boiler mode.
- .7 Factory wire each module and operationally test. Each module to be suitable for individual firing. Step firing to be accomplished by firing individual modules without reducing their thermal efficiency. Control system: designed and provided for heating boiler by manufacturer.

2.3 AUXILIARIES

- .1 Provide for each boiler and to meet ANSI/ASME requirements.
- .2 Hot water boilers:
 - .1 Relief valves: ANSI/ASME rated, set at 206 kPa.
 - .2 Pressure gauge: 90 mm diameter complete with shut-off cock.
 - .3 Thermometer: 115 mm diameter range 10 to 150°C.
 - .4 Low water cut-off: with visual and audible alarms.
 - .5 Drain valve: NPS 1.5.
 - .6 Manual reset fixed high limit set at 99°C. Wired in series with ignition system.
 - .7 Outdoor controller: to reset operating temperature controller.
- .3 Low-Loss Header
 - .1 Low-loss header shall be designed to permit variable speed pump operation on the secondary side of the header without interfering with the boiler plant operation.
 - .2 Shall be hydrostatically tested to 690kPa

- .3 Constructed of steel, externally welded. All external surfaces shall be primed and painted with corrosion-resistant paint.
- .4 Low-loss header shall be suitably sized for primary and secondary flow rates.
- .4 Condensate Neutralization Kit
 - .1 Refillable neutralization unit designed to neutralize condensate produced by gas-fired condensing boilers. Condensate released by unit shall be non-corrosive with a safe pH value of above 6.5.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Mount unit level.
- .5 Pipe hot water relief valves full size to glycol containment barrel..
- .6 Natural gas fired installations in accordance with CAN/CSA-B149.1.

3.2 MOUNTINGS AND ACCESSORIES

- .1 Safety valves and relief valves:
- .2 Run separate discharge from each valve.
- .3 Terminate discharge pipe as indicated.

3.3 COMMISSIONING

- .1 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.
 - .4 Demonstrate operation and maintenance.
- .2 Provide Departmental Representative at least 24 h notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 PA
- .2 Section 26 05 01 - Common Work Results - Electrical.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include:
 - .1 Element support details.
 - .2 kW rating, voltage, phase.
 - .3 Physical size.
 - .4 Unit support.
 - .5 Performance limitations.
 - .6 Clearance from combustible materials.
 - .7 Internal components wiring diagrams.
 - .8 Minimum operating air flow.
 - .9 Pressure drop operating at air flow.
 - .10 Thermostat

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 DUCT HEATERS

- .1 Duct heaters: flange type.
 - .2 Duct heaters to be listed for zero clearance to combustible materials.
 - .3
 - .4 Elements:
 - .1 Helical coils of nickel chrome alloy resistance wire.
 - .2 Finned tubular.
 - .3 Incoloy sheathed.
 - .5 Staging:
 - .1 Staged heaters: balanced line current at each stage.
-

- .2 Each stage: uniform face distribution.
- .6 Controls:
 - .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat.
 - .2 Over temperature protection with manual reset.
 - .3 Provide fan interlock relay with fan delay control.
 - .4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Make power and control connections in accordance with CSA C22.2 No.46.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .2 Section 25 90 01 – Site Requirements, Applications and Systems Sequences of Operation

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A153/A153M-09, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .2 Cooling Technology Institute (CTI)
 - .1 CTI-ATC-105-2000, Acceptance Test Code.
- .3 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
 - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Vibration control measures.
 - .5 Manufacturers recommended clearances.
 - .6 Field installed devices
 - .7 Controls

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Unused metal and wiring materials are to be diverted from landfill to a metal recycling facility as approved by the Departmental Representative.
- .3 Preservative treated wood must not be disposed of through incineration.
- .4 Preservative treated wood must not be disposed of with other materials destined for recycling or reuse. Treated wood, end pieces, wood scraps and sawdust must be disposed of at a sanitary landfill as approved by the Departmental Representative.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Factory assembled fluid cooler.

2.2 PERFORMANCE

- .1 Fluid Cooler:
 - .1 Capacity and performance as indicated in mechanical schedules.

2.3 SIZE AND WEIGHT

- .1 Dimensions: approximately 4.5 m x 2.4 m x 1.4 m maximum height.
- .2 Dry weight: 1230 kg.

2.4 CASING AND FRAMEWORK

- .1 Materials: galvanized steel sheet G90
- .2 Cabinet is sectionalized with individual fan chambers. Bolted construction. Coil section is independent of fan section.
- .3 Access panels: side access panels for servicing and maintenance.

2.5 COIL SECTION

- .1 Tube bundle: seamless, deoxidized, heavy wall microgrooved copper tubes. Mechanically expanded in self space, full collared aluminum corrugated plate fins. Connections and bends are brazed with high temperature brazing alloy. Tube sheets are provided with holes and tubes are supported in sliding cushions for friction free assembly and increased reliability. Header to be made with seamless copper and connections are made with pipe-threaded seamless red brass pipe. Headers to include 0.5 NPT drain and vent.
- .2 Factory test to 2.76 MPa under water.
- .3 Coil pressure drop: as indicated on mechanical schedules

2.6 FAN

- .1 Fan: aluminum blades riveted to a steel hub. Statically and dynamically balanced.
- .2 Fan drive: V-belt designed for not less than 150% of motor nameplate ratings.
- .3 Motor: size as per mechanical schedules. Permanently lubricated sealed ball bearings and inherent thermal protection for long life and dependable service.
- .4 Drives, fans, and moving parts: protected by galvanized wire guards.

2.7 ACCESSORIES

- .1 Control Panels: Complete with motor contactors and fuses per motor. Two stage aquastat, terminal block and control transformer. Control panel to provide one set of dry contacts to accept a signal from the BAS for the dry cooler leaving water temperature setpoint.
- .2 Time delay relay: to limit fan motor starts to not more than 6/h.

2.8 VIBRATION ISOLATORS

- .1 To Section 23 05 48.

Part 3 EXECUTION

3.1 GENERAL

- .1 Mount on concrete pad and vibration isolators to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.2 TEST

- .1 Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-2010, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Ratings.
 - .2 ANSI/AHRI 1060-2011, Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Underwriter's Laboratories (UL)
 - .1 UL 1995 – 2011, Heating and Cooling Equipment
- .5 National Fire Protection Agency (NFPA)
 - .1 NFPA 90A -2012, Installation of Air Conditioning and Ventilating Systems
- .6 Master Painters Institute (MPI)
 - .1 MPI-INT 5.3-2007, Galvanized Metal.

1.2 RELATED SECTIONS

- .1 Section 23 05 53.01 – Mechanical Identification
- .2 Section 23 84 13 – Humidifiers
- .3 Section 25 90 01 – Site Requirements, Applications and Systems Sequences of Operation

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate following:

- .1 Unit performance. Indicate all parameters as indicated in mechanical schedules.
- .2 Component arrangement
- .3 Fan construction, motor, operating point on performance curve
- .4 Enthalpy wheel performance at summer and winter operating conditions
- .5 Air handling unit cabinet and door construction, dimensions and weights. Include all necessary service clearances
- .6 Supply Air, Return Air, Exhaust Air, and Outdoor Air connection Points
- .7 Filters
- .8 Dampers
- .9 Preheat Coil, DX expansion coil, and drain pan construction
- .10 Water source heat pump performance and construction
- .11 Factory mounted controls
- .12 Work to be provided by others

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Include following:
 - .1 Approved equipment shop drawings
 - .2 Recommended service and preventative maintenance information
 - .3 Commissioning and testing reports

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Provide one 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.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .3 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.
-

Part 2 PRODUCTS

2.1 GENERAL

- .1 A packaged energy recovery ventilator capable of transferring sensible and latent energy with supplementary heating and cooling. Energy recovery shall be through an energy recovery wheel installed within the unit. System to include:
 - .1 Enthalpy Wheel and wheel drive system
 - .2 Ventilation air fan
 - .3 Exhaust air fan
 - .4 Heating, Cooling, and Preheat coils
 - .5 Dampers
 - .6 Temperature Sensors and Controls.
 - .7 Water source heat pumps
 - .8 Filters
- .2 All components to be factory assembled and run tested.
- .3 Unit shall be constructed in accordance with UL 1995, ASHRAE 90.1, and NFPA 90A. Unit shall be listed for use within Canada. Airflow data shall comply with ANSI/AMCA 210.
- .4 Unit nameplate shall be as indicated in Section 23 05 53.01.

2.2 CASINGS

- .1 Heavy gauge galvanized steel panels with galvanized steel frame reinforced and braced for rigidity.
 - .1 Paint cabinet with baked on enamel paint
- .2 Removable panels shall be provided to access all internal components for necessary maintenance.
- .3 Unit frame to include 150mm base rails. Unit shall have provisions for rigging and lifting integrated into the base rails of the unit.
- .4 Cabinet shall be insulated throughout with a minimum of 25mm insulation. Provide galvanized steel liner.

2.3 DRAIN PANS

- .1 Construction: stainless steel. Rounded corners.
- .2 Drain connection: in bottom at low point.
- .3 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.

2.4 FANS

- .1 Fans to be selected to operate on a stable, efficient part of the fan curve when delivering air quantities scheduled against static of the system.
-

- .2 Fan blades shall be statically and dynamically balanced and tested prior to shipment. Fan discharges and intakes to be as indicated on mechanical drawings.
- .3 Supply and exhaust fans to be forward-curved, DWDI. Fan shaft to be solid steel, turned, ground, polished, and finished off with a corrosion resistant coating. Fan wheels shall be keyed to the shaft and have pillow block bearings.
- .4 Fan drives shall be designed for a 1.3 service factor. Fan shall be equipped with an adjustable motor sheave. Drives are to be factory mounted with final alignment and belt adjustment completed before unit startup.
- .5 Maximum sound power levels, as indicated.
- .6 Mount fans on open spring vibration isolation mounts.

2.5 MOTORS

- .1 Motors shall be continuous duty and matched to the fan loads. Motors shall have ODP enclosures and include starters and overload protection.
- .2 Motors shall meet ASHRAE 90.1 for efficiency.
- .3 Motor selection must include a 1.15 service factor.
- .4 Energy wheel drive motor shall have internal overload protection.

2.6 ENTHALPY WHEEL

- .1 Enthalpy recovery performance for the wheel shall be certified by AHRI to AHRI Standard 1060. Wheels tested in independent labs and rated in accordance to AHRI Standard 1060 without AHRI certification are not acceptable
- .2 Enthalpy wheel shall conform to the requirements of NFPA-90A.
- .3 Enthalpy wheel cassette shall be complete with face seal and perimeter seal to minimize exhaust air transfer ratio when tested in accordance with AHRI Standard 1060. Exhaust air transfer ratio values must be certified to AHRI.
- .4 Enthalpy wheel shall be self cleaned by two counter flow airstreams and come equipped in slide out cassette for easy removal for maintenance.
- .5 Enthalpy wheel shall have permanently sealed ball bearings with 200,00 hour L-10 life.

2.7 DAMPERS

- .1 Unit shall include an outside air motorized damper and exhaust air motorized damper.
- .2 Dampers shall be insulated with a leakage not to exceed 25.3 l/s/m² at 250 Pa. Dampers shall be provided with extruded EPDM gasketing on the leading edges of the damper blades.
- .3 Dampers shall be parallel blade, normally closed.

2.8 FILTER BOX

- .1 Provide blank-off plates and gaskets to prevent air bypass where required.
-

- .2 Filters:
 - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media to ASHRAE 52.2 to be used on:
 - .1 Supply pre-filter.
 - .2 Minimum Efficiency Reporting Value (MERV) value 13 filtration media to ASHRAE 52.2 to be used on:
 - .1 Supply final filter.
 - .3 Immediately prior to occupancy, replace filtration media with new filtration media.

2.9 COILS

- .1 Heating and Cooling Coil
 - .1 Units shall be equipped with an integrated Water Source Heat Pump section which shall be suitable for cooling tower/boiler loop applications.
 - .2 To be UL and CSA approved.
 - .3 Evaporator coil shall include cooling and heating stages in quantities sufficient to meet the scheduled cooling and heating capacities.
 - .4 Reversible refrigerant circuits shall include externally equalized thermostatic expansion valve and reversing valve.
 - .5 Condenser shall be coaxial tube-in-tube with copper inner tubes and steel outer tubes or brazed steel plates. Condenser shall be selected with 2.7°C sub-cooling and have maximum working pressures of 2760 kPa on the water side and 4550 kPa on the refrigerant side.
 - .6 Water connections to be NPT type and mounted external to the unit.
 - .7 Refrigeration system shall incorporate a single variable speed compressor.
 - .8 Unit to be charged with R410a refrigerant, factory run and leak tested with all necessary controls for operation.
 - .9 Unit shall include refrigerant high and low pressure gauge connections.
 - .10 Unit shall include refrigerant suction and discharge valves.
- .2 Preheat Coil:
 - .1 Casings: 1.5mm thick galvanized sheet steel.
 - .1 Supports of galvanized steel channel.
 - .2 Blank-off plates. Insulated sandwich construction.
 - .2 Coil: cleanable fins.
 - .1 Tubes: copper.
 - .2 Fins: aluminum.
 - .3 Headers: cast brass.
 - .4 Pressure tests: 1.7 MPa.
- .3 Ratings: ARI certified.

2.10 CONTROLS

- .1 A recessed integral electrical control compartment shall be furnished on the side of the unit. All components shall be factory-mounted and wired to a labeled terminal strip. All components and wiring shall be identified using printed self-adhesive labels, consistent with the numbering used in the wiring diagrams.
- .2 Unit shall be equipped with preheat frost prevention to prevent frost from forming on the enthalpy wheel and allow for continuous ventilation. Unit shall come equipped with sensing and control devices for modulating control of preheat coil.
 - .1 Control valve provided by Controls Contractor.
- .3 Unit shall come equipped with a factory-installed, programmed and run tested DDC Controls Package which shall include a stand-alone microprocessor-based DDC controller and necessary sensors and interfaces to provide control of post-conditioning and pre-conditioned functions and unit operation.
- .4 An intelligent programmable interface device with remote temperature sensor shall be included for communication, display, setpoint control and to allow for servicing. Interface device to be unit mounted. Remote temperature sensor to be installed in S/A discharge duct downstream of unit by Division 25.
- .5 The DDC controller shall be native BACnet for communication with BAS. Interoperability shall be tested and approved by the BACnet Testing Laboratory. Minimum points to be provided for communication with BAS are as follows:
 - .1 Outside air temperature
 - .2 Supply air temperature
 - .3 Return air temperature
 - .4 Exhaust air temperature
 - .5 Outside air humidity
 - .6 Return air humidity
 - .7 Supply blower operation
 - .8 Cooling setpoint
 - .9 Cooling temperature band
 - .10 Heating setpoint
 - .11 Heating temperature band
 - .12 Damper positions
- .6 Safety controls for heat pump refrigeration circuit shall be auto reset on the low pressure side and manually reset on the high pressure side.
- .7 Provide unit with low leaving water temperature (freeze stat) safety switch.
- .8 Provide device and contacts to provide a 24 VAC signal when filters require replacing.
- .9 Unit shall come equipped with a wheel rotation sensor. A 24 VAC signal shall be provided if the enthalpy wheel fails.
- .10 Provide unit with a factory installed thermostat to control free cooling.
- .11 Include provision to wire a field supplied motorized on/off 2-way water shut-off valve. Valve shall be interlocked with unit to turn off water flow when the unit compressor is off.

- .12 All unit safety controls shall be factory mounted and wired, requiring only field installation of remote sensing devices.
- .13 Interlock exhaust air and outside air damper position with fan operation. A signal shall be sent if the dampers fail.
- .14 Refer to Section 25 90 01 for Sequences of Operation.

2.11 HUMIDIFIERS

- .1 In accordance with Section 23 84 13.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Ducts to be connected to unit inlet and outlet collars with flexible duct collars to Section 23 33 00

3.3 FANS

- .1 Install fan sheaves required for final air balance.

3.4 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.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Acceptable Materials: Where materials are specified by trade name refer to the General Instructions to Bidders for procedure to be followed in applying for approval: SACC Manual Clause ID R2410T for GI14 Approval of Alternative Materials, or, SACC Manual Clause ID R2710T for GI16 Approval of Alternate Materials.

1.2 RELATED SECTIONS

- .1 Section 23 07 15 – Thermal insulation for Piping
- .2 Section 23 23 00 – Copper Tubing and Fittings Refrigerant
- .3 Section 25 30 02 – Field Control Devices
- .4 Section 25 90 01 – Site Requirements, Applications and Systems Sequences of Operation

1.3 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 210/240-2008, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI 320-1998, Standard for Water-Source Heat Pumps.
- .3 CSA International
 - .1 CAN/CSA-C656-05(R2010), Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.
 - .2 CAN/CSA-C13256-2001(R2011), Water-Source Heat Pumps-Testing and Rating for Performance, Part 1 Water-to-Air and Brine-to-Air Heat Pumps.
 - .3 CAN/CSA- B52-05 (R2009), Mechanical Refrigeration Code.
- .4 Environment Canada, (EC) / Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for Installation of Air Conditioning and Ventilating Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for:
-

- .1 Water-Source Outdoor Units
- .2 Indoor Fan Coil Units
- .3 Air-Source Outdoor Units
- .4 Refrigerant Piping Accessories
- .5 Heat Recovery Units
- .6 Standalone LCD controller and Wiring Diagrams
- .7 BACnet interface Gateway
- .2 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Unit Tag Identification
 - .2 Dimensions and Weights
 - .3 Performance Characteristics and Operating Conditions
 - .4 Colour and Finish
 - .5 Electrical Characteristics
 - .6 Required Field Coordination
 - .7 Equipment Connections
 - .8 Total Refrigerant Charge
 - .2 Water-cooled and Air-cooled VRF system manufacturer to provide complete piping layout and system schematic for review. Layout to be completed with manufacturer's selection software and drawn on floor plans provided by Department Representative.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
- .3 Manufacturer's limited warranty.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

1.7 WARRANTY

- .1 All equipment shall be provided with a limited manufacturer's warranty for a period of one year after the date of installation or 18 months from date of delivery, whichever is shorter.
- .2 An optional extended warranty including 1 additional year parts and 5 additional years compressor shall be provided upon submission to the manufacturer and acceptance by the manufacturer of proper installation with documentation including:
 - .1 Selection output and layout of the VRF system.
 - .2 60 minutes of operation history upon commissioning from the VRF service tool.
 - .3 Completed commissioning report as per the VRF equipment manufacturer.

Part 2 PRODUCTS

2.1 DESCRIPTION

- .1 System shall be a VRF(Variable Refrigerant Flow) capable of heat recovery and simultaneous cooling and heating. System shall be air cooled or water cooled as indicated on mechanical drawings and equipment schedules.
- .2 System shall consist of outdoor units, heat recovery units, indoor units, and controls by the equipment manufacturer. Equipment controls shall be capable of operating as a stand alone system and communicating with the building automation system with the BACnet communication protocol.
- .3 Every indoor unit shall be independently capable of operating in either heating or cooling mode regardless of the mode of the other indoor units.

2.2 ACCEPTABLE MATERIAL

- .1 LG, Multi V Water II Heat Recovery, manufactured by LG, 1-(888)-542-2623, fax: 1-(647)-724-0083, www.lgvrf.ca, distributed by O'Dell Associates Inc 1-(519)-772-0386, fax: 1-(519)-772-1029, www.odellassoc.com
- .2 Daikin, VRV-WIII, manufactured by Daikin AC (Americas), Inc., 1-(212) 340-7400, fax: 1-(212) 779-5925, www.daikin.com, distributed by HTS Engineering, 1-(519)-748-1860, fax: 1-(519) 784-9466, www.htseng.com
- .3 Mitsubishi Electric, WR2-Series, manufactured by Mitsubishi Electric, 1-(905) 475-7728, fax: 1-(905) 475-6897, www.mitsubishielectric.ca, distributed by Mits Airconditioning Inc., 1-(800)-567-2221, fax: (905) 564-2205, www.mitsair.com

2.3 REFRIGERANTS

- .1 Type of Refrigerant: R-410a.

2.4 AIR-SOURCE HEAT PUMP

- .1 General:
 - .1 Four component VRF unit consisting of outdoor unit, indoor fan coils, manufacturer refrigerant piping and components, and controls.
 - .2 System components shall be from a single manufacturer.

- .3 Unit control boards shall perform all functions required to effectively and efficiently operate the VRF system and communicate from outdoor unit to indoor units.
- .4 Outdoor unit shall be completely factory assembled, piped and wired. Each outdoor unit shall be run tested at the factory.
- .5 Outdoor unit shall have the ability to operate with an elevation difference of up to 50m above or 40m below the indoor units.
- .6 The outdoor unit shall be capable of operating in heating only mode down to -20°C and up to 16°C ambient wet bulb without additional low ambient controls.
- .7 The outdoor unit shall be capable of operating in cooling only mode down to -28°C and up to 48°C ambient dry bulb.
- .8 The outdoor unit shall have an oil separator for the compressor and controls to ensure sufficient oil supply is maintained for the compressor.
- .9 Field installed refrigerant piping between outdoor and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
- .2 Performance data: as indicated in mechanical schedules
- .3 Frame:
 - .1 Shall be constructed with galvanized steel, bonderized and be finished with powder coat baked enamel paint.
- .4 Compressor:
 - .1 Welded hermetic digitally controlled inverter driven rotary compressor. Crankcase heater shall be factory mounted on the compressor. Compressor shall be mounted to avoid the transmission of vibration.
 - .2 Compressor shall have an inverter to modulate capacity.
 - .3 Other components to include:
 - .1 Accumulator
 - .2 High pressure safety switch
 - .3 Over-current protection
 - .4 Subcooling heat exchanger
 - .5 Internal thermal overload
- .5 Fan:
 - .1 Condenser fans shall be direct drive, variable speed.
 - .2 All fan motors shall have inherent protection, have permanently lubricated bearings and be variable speed.
 - .3 All fans shall be provided with a raised guard to limit contact with moving parts.
- .6 Coil:
 - .1 The outdoor coil shall be of nonferrous construction with louvered fins on copper tubing.
 - .2 The coil fins shall have a factory applied corrosion resistant, hydrophilic coating.
 - .3 The coil shall be protected with an integral metal guard.

- .4 Refrigerant flow from the outdoor unit shall be controlled by means of a digitally controlled inverter driven rotary compressor.
- .7 Refrigeration piping:
 - .1 Between outdoor unit, compressor section and indoor coil, complete with refrigerant metering devices and valves.
 - .2 Refer to Section 23 23 00.
- .8 Electrical:
 - .1 Unit to be capable of operation within voltage limits of +/- 10% rated voltage.
 - .2 Outdoor unit shall be controlled by integral microprocessors.
 - .3 The control circuit between the indoor units and the outdoor unit shall be 24VDC. Communication shall be using 2-conductor, stranded, shield cable for RS485 daisy chain.
- .9 Controls:
 - .1 Individual indoor units connected to air cooled condensing unit shall be controlled with individual remote mounted thermostats.
 - .2 Thermostats shall be supplied by VRF equipment manufacturer.
 - .3 Unit shall be capable of interfacing with building automation system. The following points shall be provided:
 - .1 Start/Stop
 - .2 Cool or Heat Changeover
 - .3 Status
 - .4 Error/Alarm

2.5 WATER SOURCE HEAT PUMP

- .1 General:
 - .1 Provide one or more water source outdoor units capable of heat recovery and meeting the performance listed in the mechanical schedules.
 - .2 Outdoor units shall have integrated controls system capable of stand-alone operation and communication with the building automation system through the BACnet communication protocol.
- .2 Frame and Casing:
 - .1 The frame shall be constructed with galvanized steel, bonderized, and finished with powder coat baked enamel paint.
 - .2 The outdoor unit case is constructed from 19-gauge metal, and is cleaned and finished with a baked enamel finish.
 - .3 Provide standard manufacturer support frames for wall mounting.
- .3 Refrigeration system:
 - .1 Field installed refrigerant piping between heat recovery unit, outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
 - .2 Outdoor unit shall be provided with factory installed components including:

- .1 Refrigerant strainer;
 - .2 Check valves;
 - .3 Oil separator;
 - .4 Accumulator;
 - .5 Hot gas bypass valve;
 - .6 Liquid injection valve;
 - .7 4-way reversing valve;
 - .8 Electronic expansion valve;
 - .9 High and low side charging ports;
 - .10 Integral subcooler with electronic expansion valve;
 - .11 Service valves;
 - .12 Interconnecting piping;
- .3 Refrigerant oil level in the compressor is maintained using a two-stage oil control system. The high-pressure discharge vapor leaves the compressor and immediately enters the oil separator designed to extract oil from the refrigerant gas stream. The oil separator has no moving parts. A gravity drain returns captured oil back to the compressor sump. The water source unit microprocessor is programmed to flush the refrigerant piping for a minimum period of three minutes after six hours of compressor operation.
- .4 Compressor:
- .1 Outdoor unit to contain one or more compressors. At minimum one of the compressors must be a hermetic, digitally-controlled, inverter driven scroll compressor. Compressor motor is suction gas-cooled and has an acceptable voltage range of +/- 10% of nameplate voltage. The compressor is equipped with a crankcase heater and back seated service valves.
 - .2 If multiple compressors are provided, additional compressors may be constant speed. The constant speed compressor has an acceptable voltage range of +/- 10% of nameplate voltage, uses polyvinylether refrigerant oil, and has Teflon coated bearings.
 - .3 An external pressure sensor and an external temperature sensor are provided to protect the compressor from damage caused by over/under temperature or over/under pressure conditions. The compressor is provided with a positive displacement oil pump providing sufficient oil film on all bearing surfaces across the entire inverter modulation range. The compressor oil shall be polyvinylether. Compressor bearings are Teflon coated.
 - .4 Compressors shall be mounted in a heat resistant, sound attenuating blanket and mounted on rubber isolation grommets.
- .5 Heat Exchanger
- .1 Water heat exchanger is stainless steel, type SUS316, refrigerant/water plate heat exchanger.
- .6 Controls
-

- .1 Water source units are factory wired with electrical control components, printed circuit boards, thermistors, sensors, terminal blocks, and lugs for power wiring. The control wiring circuit is low voltage and includes a control power transformer, fuses, and interconnecting wiring harness with plug connectors.
- .2 Microprocessor-based algorithms provide component protection, soft-start capability, defrost, ambient control, and refrigerant system pressure and temperature control.
- .3 The unit is designed to provide continuous compressor operation with an entering water temperature of 10°C-45°C for cooling mode and -5°C and 45°C for heating mode.
- .4 The outdoor unit shall automatically assign an electronic address to each connected indoor unit by the outdoor unit's microprocessor. Each indoor unit shall also be capable of accepting a manually assigned secondary address which acts as a unit tag identification.
- .5 In 10-second intervals, the water source unit microprocessor records the last three minutes of system run-time data in non-volatile memory. Upon unit malfunction, or power outage that results in a system shutdown, the stored system operational data may be retrieved and analyzed to assist in diagnosing a system malfunction.
- .6 The outdoor unit microprocessor is provided with a three-digit LED display that communicates active system information and/or malfunction codes.
- .7 The microprocessor has an algorithm that actively verifies the operation condition of system sensors and thermistors.
- .8 The microprocessor shall have a refrigerant auto-trim-charge algorithm that assists the installer with properly charging the system.
- .9 A power conditioning circuit is provided and designated to protect the unit's inverter compressor and controls from phase failure, phase reversal, over/under voltage condition, and to prevent transmission of power irregularities to the supply power source.

2.6 HEAT RECOVERY UNITS

- .1 General:
 - .1 The heat recovery unit shall be provided by the manufacturer and installed as part of the system to permit simultaneous heating and cooling operation.
 - .2 Heat recovery unit shall house piping, valves and control to divert refrigerant controlling each port to operate in either heating or cooling mode.
- .2 Casing and Construction:
 - .1 Heat recovery units are to be completely factory assembled, internally piped, wired and designed for indoor operation.
 - .2 Casing is to be constructed of galvanized steel.
 - .3 Heat recovery units contain one subcooling heat exchanger per port and are internally insulated and do not require a condensate drain.
- .3 Refrigerant Valves:
 - .1 Each heat recovery port is circuited with two two-position solenoid valves to control the refrigerant flow path.

- .4 Refrigerant System:
 - .1 Field installed refrigerant piping between heat recovery unit, outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
 - .2 Heat recovery units can be piped in series or parallel to minimize material cost and labor.
- .5 Electrical:
 - .1 Heat recovery units capable of operating within +/- 10% of nominal voltage.
- .6 Controls:
 - .1 Heat recovery units include factory installed control boards and integral microprocessors that communicate with the main control board in the outdoor unit and interface with the VRF equipment controls system. The control circuit between the indoor units, heat recovery units, and the outdoor unit is to be 24VDC. Communication shall be over a daisy chain system.

2.7 WALL-MOUNTED INDOOR UNIT

- .1 General:
 - .1 Wall-mounted indoor units shall protrude from the wall no more 250mm.
 - .2 Shall be designed for use with R410a refrigerant.
 - .3 Shall be of the same manufacturer of simultaneous heating and cooling heat pump VRF systems.
 - .4 Shall communicate with the outdoor unit and heat recovery units using daisy chain communication.
 - .5 Field installed refrigerant piping between heat recovery unit, outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
- .2 Indoor Unit
 - .1 Shall be factory assembled, wired and run tested.
 - .2 The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
 - .3 The indoor unit shall have a self-diagnostic function and auto restart function.
 - .4 The indoor unit shall be filled with a dry nitrogen gas charge from the factory.
- .3 Unit Cabinet
 - .1 The unit casing shall have a white finish.
 - .2 Multi direction refrigerant piping up to four directions.
 - .3 Multi direction drain piping up to two directions.
 - .4 The indoor unit shall attach to a separate back plate that secures the unit to the wall.
- .4 Filter:
 - .1 Return air shall be filtered with a factory supplied removable, washable filter.
- .5 Fan:

- .1 The indoor unit fan shall be an assembly with one cross flow fan direct driven by a single motor.
- .2 The indoor fan shall be statically and dynamically balanced.
- .3 Motor shall have permanently lubricated bearings.
- .4 Provided fan settings shall be Low, Med, High, Power Cool (Cooling Mode), and Auto.
- .5 Fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
- .6 A manually adjustable guide vane shall be factory installed allowing the ability to control the direction of airflow from side to side.
- .6 Coil:
 - .1 The indoor unit coil shall be nonferrous with louvered fins on copper tubing.
 - .2 The tubing shall have inner grooves.
 - .3 Coils shall be pressure tested at the factory.
 - .4 A condensate drain pan shall be factory installed below the coil.
- .7 Condensate Pump:
 - .1 Provide unit with factory mounted or field installed condensate pump. Condensate pump performance to be 6lph at 3m head.
 - .2 Electrical and installation requirements to be coordinated with electrical contractor and mechanical contractor.
 - .3 Condensate pump electrical power shall be 208V, 1-phase, 60 Hz.
- .8 Electrical:
 - .1 The indoor unit electrical power shall be 208/230V, 1-phase, 60 Hz.
 - .2 The indoor unit shall be capable of operation within the voltage limits of +/- 10% of the rated voltage.
- .9 Controls:
 - .1 Unit shall use controls provided by the manufacture to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over a RS485 daisy chain communication system.
 - .2 Provide with wall mounted temperature sensor manufactured by VRF equipment manufacturer or thermostat as indicated on floor plans.
- .10 Sound Pressure Levels
 - .1 Fan coil units FC-4, FC-8, FC-14, FC-30, FC-31 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
47 dB	39 dB	40 dB	40 dB	39 dB	34 dB	26 dB	16 dB

2.8 CEILING CASSETTE INDOOR UNIT

- .1 General:
 - .1 Two-way ceiling cassette indoor units shall recess into the ceiling and mount flush.
 - .2 Shall be designed for use with R410a refrigerant.
 - .3 Shall be of the same manufacturer of simultaneous heating and cooling heat pump VRF systems.
 - .4 Shall communicate with the outdoor unit and heat recovery units using daisy chain communication.
 - .5 Field installed refrigerant piping between heat recovery unit, outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
- .2 Indoor Unit
 - .1 Shall be factory assembled, wired and run tested.
 - .2 The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
 - .3 The indoor unit shall have a self-diagnostic function and auto restart function.
 - .4 The indoor unit shall be filled with a dry nitrogen gas charge from the factory.
- .3 Unit Cabinet and Grille
 - .1 The unit cabinet shall be designed to recess into the ceiling.
 - .2 The indoor unit vanes shall be capable of automatically swinging the vanes up and down for uniform air distribution. Vanes shall also be capable of being stopped at any position during swing operation.
- .4 Filter:
 - .1 Return air shall be filtered with a factory supplied removable, washable filter.
- .5 Fan:
 - .1 The indoor unit fan shall be an assembly with two cross flow fan each direct driven by a single motor.
 - .2 The indoor fan shall be statically and dynamically balanced.
 - .3 Motor shall have permanently lubricated bearings.
 - .4 Provided fan settings shall be Super Low, Low, Med, High, Power Cool (Cooling Mode), and Auto.
 - .5 Fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
- .6 Coil:
 - .1 The indoor unit coil shall be nonferrous with louvered fins on copper tubing.
 - .2 The tubing shall have inner grooves.
 - .3 Coils shall be pressure tested at the factory.
 - .4 A condensate drain pan shall be factory installed below the coil.
- .7 Condensate Pump:

- .1 The unit shall include a factory installed condensate pump that will be able to raise drain water 675mm above the ceiling cassette face.
- .8 Electrical:
- .1 The indoor unit electrical power shall be 208/230V, 1-phase, 60 Hz.
- .2 The indoor unit shall be capable of operation within the voltage limits of +/- 10% of the rated voltage.
- .9 Controls:
- .1 Unit shall use controls provided by the manufacture to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over a RS485 daisy chain communication system.
- .2 Provide with wall mounted temperature sensor manufactured by VRF equipment manufacturer.
- .10 Sound Pressure Levels
- .1 Ceiling cassette fan coil units are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
54 dB	48 dB	42 dB	38 dB	36 dB	34 dB	32 dB	25 dB

2.9 DUCTED CONCEALED INDOOR UNIT

- .1 General:
 - .1 Ceiling concealed duct indoor unit shall mount fully concealed within the ceiling.
 - .2 Shall be designed for use with R410a refrigerant.
 - .3 Shall be of the same manufacturer of simultaneous heating and cooling heat pump VRF systems.
 - .4 Shall communicate with the outdoor unit and heat recovery units using daisy chain communication.
 - .5 Field installed refrigerant piping between heat recovery unit, outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
 - .2 Indoor Unit
 - .1 Shall be factory assembled, wired and run tested.
 - .2 The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
 - .3 The indoor unit shall have a self-diagnostic function and auto restart function.
 - .4 The indoor unit shall be filled with a dry nitrogen gas charge from the factory.
 - .3 Unit Cabinet and Grille
 - .1 The unit cabinet shall be ceiling concealed and ducted.
 - .4 Filter:
 - .1 Return air shall be filtered with a factory supplied removable, washable filter.
 - .5 Fan:
 - .1 The indoor unit fan shall be no more than one assembly with two fans direct driven by a single motor.
 - .2 The indoor fan shall be statically and dynamically balanced.
 - .3 Motor shall have permanently lubricated bearings.
 - .4 Provided fan settings shall be Low, Med, High, Power Cool (Cooling Mode), and Auto.
 - .6 Coil:
 - .1 The indoor unit coil shall be nonferrous with louvered fins on copper tubing.
 - .2 The tubing shall have inner grooves.
 - .3 Coils shall be pressure tested at the factory.
 - .4 A condensate drain pan shall be factory installed below the coil.
 - .7 Condensate Pump:
 - .1 The unit shall include a factory installed condensate pump that will be able to raise drain water 675mm above the ceiling cassette face.
 - .8 Electrical:
 - .1 The indoor unit electrical power shall be 208/230V, 1-phase, 60 Hz.
-

.2 The indoor unit shall be capable of operation within the voltage limits of +/- 10% of the rated voltage.

.9 Controls:

.1 Unit shall use controls provided by the manufacture to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over a RS485 daisy chain communication system.

.2 Provide with wall mounted temperature sensor manufactured by VRF equipment manufacturer.

.10 Sound Pressure Levels

.1 Fan coil unit, FC-1 is to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
46 dB	50 dB	46 dB	42 dB	41 dB	35 dB	22 dB	14 dB

.2 Fan coil units FC-2, FC-5, FC-6, FC-7, FC-17, FC-18, FC-20, FC-23, FC-25 FC-26, FC-27 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
34 dB	42 dB	39 dB	32 dB	28 dB	18 dB	17 dB	16 dB

.3 Fan coil units FC-3 is to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
46 dB	47 dB	39 dB	38 dB	34 dB	29 dB	20 dB	14 dB

.4 Fan coil units FC-9, FC-24 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
44 dB	50 dB	45 dB	41 dB	36 dB	30 dB	18 dB	14 dB

.5 Fan coil units FC-10, FC-12, FC-13, FC-19 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
35 dB	43 dB	40 dB	32 dB	37 dB	18 dB	17 dB	16 dB

.6 Fan coil units FC-11, FC-21 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
36 dB	46 dB	45 dB	34 dB	30 dB	23 dB	22 dB	17 dB

.7 Fan coil units FC-16, FC-28, FC-29 are to not exceed the following sound pressure levels.

63 hz	125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz
44 dB	48 dB	43 dB	40 dB	36 dB	32 dB	22 dB	16 dB

2.10 CONTROLLERS

- .1 Provide BACnet Gateway capable of connecting to existing BAS system using the BACnet/IP protocol. Gateway shall be capable of controlling up to a minimum of 10 outdoor units and 100 indoor units. Gateway shall have capability to interface with building fire alarm to disable system on a fire signal.
- .2 Gateway to be preprogrammed by manufacturer with all operating points and user adjustable settings for indoor and outdoor units.
- .3 System shall be capable of reading the following points on indoor units:
 - .1 ON/OFF
 - .2 Operation Mode
 - .3 Fan Speed
 - .4 User Mode
 - .5 Room Temperature
 - .6 Filter Status
 - .7 Alarm
 - .8 Error Code
- .4 System shall be capable of read/writing the following points on indoor units:
 - .1 ON/OFF
 - .2 Operation Mode
 - .3 User Mode
 - .4 Fan Speed
 - .5 Set Room Temperature
 - .6 Filter Status Reset

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for VRF system 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.

3.2 INSTALLATION

- .1 Install where indicated and in accordance with manufacturer's instructions.
 - .2 Install water source outdoor units manufacture's provided framing or floor mount on housekeeping pad. Install air source outdoor units on exterior concrete pad.
-

- .3 Inlet water piping to outdoor unit to be provided with a 50 mesh strainer. Strainer to be provided by and installed by Division 23.
- .4 Secure with hold-down bolts in accordance with manufacturer's recommendations.
- .5 Make duct connections through flexible connections.
- .6 Level unit with fans running. Align duct work flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .7 Make piping connections.
- .8 Nothing to obstruct ready access to components or to prevent removal of components for servicing.
- .9 Provide refrigerant isolation valves on heat recovery box ports that connect to other heat recovery boxes or outdoor condensing units.

3.3 DRAIN PANS

- .1 Install so that no water can accumulate. Arrange easy access for cleaning.
- .2 Include internal or external trap for proper draining.

3.4 START-UP AND COMMISSIONING

- .1 Prior to connecting equipment to condenser loop and start up, condenser water piping to be thoroughly cleaned and appropriate water treatment systems in place and operating.
- .2 Have manufacturer certify installation.
- .3 Have manufacturer present tests and start up units and certify performance.
- .4 Submit written start-up and commissioning reports to Departmental Representative.

3.5 CLOSEOUT ACTIVITIES

- .1 Manufacturer to deliver verbal and written instructions to operating personnel.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 25 90 01 – Site Requirements, Applications and System Sequences of Operations

1.2 REFERENCES

- .1 ARI
 - .1 ARI Standard 440-97
- .2 CSA International
 - .1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-08, Enclosures for Electrical Equipment (1000 V Maximum).
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for forced air heaters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FORCED AIR HEATERS - ELECTRIC

- .1 Forced air heaters, recessed ceiling mounted commercial type as follows:
 - .1 Enclosure:
 - .1 Steel, 20 gauge.
 - .2 Knockouts for wiring connections
 - .3 Bar grille inlet and outlet
 - .4 Suitable for recessed mounting
 - .2 Elements, Motor, and Fan:
 - .1 Element: Nickel chromium alloy within a steel sheath. Spiral steel fins brazed to surface.
 - .2 Motor: Totally enclosed, permanent split capacitor motor with integral thermal overload protection. Permanently lubricated. Motors capable of operating at +/- 10% rated voltage.
 - .3 Fan: Aluminum fan, 5 wheel mixed flow. Fan to be anodized.
 - .3 Accessories:
 - .1 Unit mounted disconnect switch
 - .2 Controls:
 - .1 Unit mounted thermostat.
 - .3 Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.
 - .4 Force Air heater to be UL approved and CSA certified.

2.2 FORCED AIR HEATERS - HYDRONIC

- .1 Forced air heaters, recessed ceiling mounted commercial type as follows:
 - .1 Enclosure:
 - .1 Steel, 16 gauge.
 - .2 Left hand or right hand configuration.
 - .3 Bar grille inlet and outlet
 - .4 Painted with a backed powder finish. Finish to be white. Finish to meet ASTM B117 Salt spray test.
 - .2 Coils, Motor, and Fan:
 - .1 Coils: 15mm outside diameter seamless copper tubes mechanically expanded within corrugated aluminum fins. Coils to be designed for a working pressure up to 1034 kPa

- .2 Motor: Permanent split capacitor motor with integral thermal overload protection. Self aligning sleeve bearings. Motors capable of operating at +/- 10% rated voltage.
- .3 Fan: Twin centrifugal double-inlet double-width fans mounted on double-shafted motors. Fan wheels and fan housings to be corrosion resistant.
- .3 Filters:
 - .1 Filters are concealed from sight and removable through bottom access panel. Filters to be 25 mm pleated media throwaway.
- .2 Controls:
 - .1 Unit mounted thermostat.
 - .3 'On-Off-Fan Only' selector switch and temperature control knob.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install heaters in accordance with manufacturer's written recommendations.
- .2 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Hydronic Institute of Boiler and Radiator Manufacturers (IBR)

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
 - .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Enclosures.
 - .4 Finish Colour

1.3 CLOSEOUT SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 CAPACITY

- .1 As indicated, based on 82°C average water temperature, 11°C temperature drop and 18.3°C at entering air temperature.

2.2 FINNED TUBE RADIATION

- .1 Heating elements: NPS 3/4 seamless copper tubing, 1.2 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 70 x 100 mm nominal, 160 fins per metre suitable for sweat fittings.
- .2 Element hangers: plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.

- .3 Standard enclosures: 16 Ga. thick steel complete with components for wall-to-wall with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height to be 300mm. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Finish cabinet with factory applied baked primer coat. Colour to be white.
- .4 Outlets: aluminum bar grille top outlet, open bottom inlet.
- .5 Dimensions for enclosures: Measure site conditions. Do not scale from drawing.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .6 Valves
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating gate valves on inlet and lockshield globe balancing valves on outlet of each unit.
- .7 Venting:
 - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
 - .2 Install standard air vent with cock on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators as indicated.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 25 30 02 – EMCS: Field Control Devices.
- .2 Section 25 90 01 – EMCS: Site Requirements Applications and Systems Sequences of Operation

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
- .2 Underwriter's Laboratories of Canada (ULC)
- .3 ARI 640 – Standard for Commercial and Industrial Humidifiers

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Indicate following:
 - .1 Capacity
 - .2 Dimensions
 - .3 Mounting arrangements for humidifier and steam dispersion wand
 - .4 Controls
 - .5 Work to be completed by others

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Manufacturer's warranty certificate.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .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.

1.7 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

1.8 WARRANTY

- .1 Product shall be warranted to be free from defects in material and workmanship for a period of two years after installation.

Part 2 PRODUCTS

2.1 PACKAGED ELECTRODE STEAM GENERATING TYPE

- .1 CSA certified and ULC listed.
- .2 Provide electrode steam generating system capable of operating on regular or softened potable water.
- .3 Unit to be packaged, wall mounted with duct mounted steam distributor.
- .4 Atmospheric pressure steam generation and mineral separation contained within a factory sealed disposable steam cylinder complete with factory installed electrodes to suit water condition. Resistive element technology and pressure steam technology not acceptable. The disposable electrode steam cylinder shall have:
 - .1 Published life expectancy
 - .2 Published replacement pricing
 - .3 Integral electronics to ensure safe operation
 - .4 Efficient operation over a wide range of water conditions
 - .5 Removable from humidifier without removing humidifier and requiring no special tools
 - .6 Full output and maximum energy efficiency through entire cylinder life
 - .7 Draining shall be through the bottom
 - .8 Safety characteristics to include no current flow when water is not present in the cylinder
- .5 Unit to be complete with:
 - .1 Factory installed and programmed microprocessor to control all humidifier functions with interface capabilities for remote communication. Remote communication shall be compatible with BACnet MSTP protocol.
 - .2 Microprocessor controlled fill valve and drain valve allowing automatic water management.
 - .3 Isolated plumbing and electrical compartment. Modular plumbing and electrical fully assembled and pre-wired. Plumbing door to have an electrical safety interlock to disrupt power when installing or servicing the humidifier.
 - .4 Internal drain water tempering to ensure maximum 60°C drain water.
 - .5 Integral fill cup with minimum 25mm air gap to prevent back siphoning.
 - .6 Controls to manage cylinder operation including:
 - .1 Cylinder identification with model, data, and capacity

- .2 Cylinder self diagnostics ensuring safe operation
- .3 End of cylinder life status
- .4 Cylinder run time in hours
- .5 Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life
- .7 Automatic shut down when humidifier has not been used for a period of three days. Humidifier to completely drain the cylinder and automatically restart on a call for humidity.
- .8 Accepts a signal from the BAS system or modulating humidistat.
- .6 Controller to include:
 - .1 Full function user interface with touch type keypad and backlit alphanumeric graphic display with trend log
 - .2 Real time clock complete with battery backup
 - .3 Built-in controller with adjustable set point, proportional range, and integral for use with humidity transducers.
 - .4 Accepts industry standard analog continuous control demand signal 4-20mA relative humidity transducer
 - .5 Keypad programming to configure, monitor and control humidifier parameters on graphic backlit display
 - .1 Relative humidity set point and actual conditions in duct from humidity transducer.
 - .2 Relative humidity high limit set point and actual humidity from transducer.
 - .3 System demand in kg/hr.
 - .4 On screen service history with date stamp.
 - .5 On screen fault history with troubleshooting list and date stamp.
 - .6 On screen attention indication.
 - .7 Cylinder model number and capacity rating.
 - .8 Humidifier run time weighted hours.
 - .9 Short cycling detection and correction diagnostics.
 - .10 Adjustable flush cycle timer
 - .11 Air flow status from remote airflow switch
 - .6 BAS integration to read the following points:
 - .1 Change Cylinder
 - .2 System Demand
 - .3 Remote fault indication
 - .4 Remote Status indication
 - .7 BAS integration to read/write the following points:
 - .1 Humidifier input value – 0%-100%
 - .2 Relative humidity setpoint
 - .3 Demand in %RH
 - .4 Remote Disable/Enable

- .7 Duct distribution header complete with condensate drain and supply hose.
 - .1 Distributor tube to be made of stainless steel.
 - .2 Distributor to be of suitable size and length for rated steam generation capacity of humidifier and duct width.
 - .3 Distributor to have an integral condensate return, allowing for condensate produced at the distributor to be drained back to floor drain.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install humidistat as indicated on drawings. Maintain required clearances.
- .3 Install access doors or panels in adjacent ducting downstream of humidifier dispersion wand.
- .4 Seal humidifier dispersion-tube duct penetrations with flange.
- .5 Mount dispersion-tube 1/3 up from bottom of duct. Secure opposite end of dispersion-tube to duct. Dispersion tube to be mounted 400mm downstream of any fitting. Steam dispersion-tube to be installed level within duct.
- .6 Slope steam and condensate piping at 15° up from humidification unit. Install p-trap in condensate piping suitably sized for duct pressure at point of steam dispersion wand. Drain condensate to floor drain.

3.2 START-UP

- .1 General: In accordance with Section 01 91 00: General Requirements, supplemented as specified herein.
- .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapour 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 vapour.
 - .2 Freedom from water deposits.

3.3 PERFORMANCE VERIFICATION (PV)

- .1 General: In accordance with Section 01 91 00: General Requirements, supplemented as specified herein.
- .2 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.
- .3 Manufacturer's Field Service:

- .1 Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Inspections to include:
 - .1 Leak test
 - .2 Operation test
 - .3 Test and adjust controls and safeties
 - .4 Test high limit humidistat

3.4 REPORTS

- .1 General: In accordance with Section 01 91 00: Reports, supplemented as specified herein.
- .2 Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information Report Forms.
 - .3 Manufacturer's field service test results.

3.5 TRAINING

- .1 Refer to Section 01 91 00: Training of O&M Personnel.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.
 - .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with 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.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Final Report: submit report to Departmental 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 Departmental 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 Departmental Representative in accordance with Section 01 78 00.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

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

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 00.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.
- .3 Inform, and obtain approval from, Departmental 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 Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

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

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.
-

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 EXECUTION

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Departmental 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.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .2 General: consists of field tests of equipment just prior to installation.
 - .3 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
 - .4 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.
 - .5 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .6 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
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- .7 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.
- .8 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
- .9 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
- .10 Transmitters above 0.5% error will be rejected.
- .11 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. 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 Departmental Representative and provide:
 - .1 Two (2) technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Departmental 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 Departmental 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 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 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 Departmental Representative to verify reported results.

3.3 ADJUSTING

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

3.4 DEMONSTRATION

- .1 Demonstrate to Departmental 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.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00, 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 co-ordinated 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.

1.4 QUALITY ASSURANCE

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

1.5 INSTRUCTIONS

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

1.6 TIME FOR INSTRUCTION

- .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).

1.7 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).

1.8 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 3 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - .2 Equipment maintenance training: provide personnel with 1 days training within 1 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .3 Programmers: provide personnel with 2 days training within 3 day period in following subjects in approximate percentages of total course shown:
 - .1 Software and Architecture: 10%
 - .2 Application Programs: 15%
 - .3 Controller Programming: 20%
 - .4 Troubleshooting and Debugging: 40%
 - .5 Colour Graphic Generation: 15%

1.9 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.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 09 91 99 – Painting for Minor Works
 - .2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .3 Section 25 05 54 - EMCS: Identification.
 - .4 Section 25 30 01 – EMCS: Building Controllers
 - .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-2012, BACnet - A Data Communication Protocol for Building Automation and Control Networks.
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-00(R2011), Metric Practice Guide. (Withdrawn)
- .4 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-C-2010 (ANSI), Control Network Protocol Specification.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .6 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .8 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE 260.1-2004, IEEE Standard Letter Symbols for Units of Measurement (SI Customary Inch-Pound Units, and Certain Other Units).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .2 AEL - Average Effectiveness Level.
 - .3 AI - Analog Input.
 - .4 AIT - Agreement on International Trade.
 - .5 AO - Analog Output.
 - .6 BACnet - Building Automation and Control Network.
 - .7 BC(s) - Building Controller(s).
 - .8 BECC - Building Environmental Control Center.
 - .9 CAD - Computer Aided Design.
 - .10 CDL - Control Description Logic.
 - .11 CDS - Control Design Schematic.
 - .12 COSV - Change of State or Value.
 - .13 CPU - Central Processing Unit.
 - .14 DI - Digital Input.
 - .15 DO - Digital Output.
 - .16 DP - Differential Pressure.
 - .17 ECU - Equipment Control Unit.
 - .18 EMCS - Energy Monitoring and Control System.
 - .19 HVAC - Heating, Ventilation, Air Conditioning.
 - .20 IDE - Interface Device Equipment.
 - .21 I/O - Input/Output.
 - .22 ISA - Industry Standard Architecture.
 - .23 LAN - Local Area Network.
 - .24 LCM - Local Control Module.
 - .25 LCU – Local Control Unit
 - .26 MCU - Master Control Unit.
 - .27 NAFTA - North American Free Trade Agreement.
 - .28 NC - Normally Closed.
 - .29 NO - Normally Open.
 - .30 OS - Operating System.
 - .31 O&M - Operation and Maintenance.
 - .32 OWS - Operator Work Station.
 - .33 PC - Personal Computer.
 - .34 PCI - Peripheral Control Interface.
 - .35 PCMCIA - Personal Computer Micro-Card Interface Adapter.
 - .36 PID - Proportional, Integral and Derivative.
 - .37 RAM - Random Access Memory.
 - .38 ROM - Read Only Memory.
 - .39 SP - Static Pressure.
 - .40 TCU - Terminal Control Unit.
-

- .41 USB - Universal Serial Bus.
- .42 UPS - Uninterruptible Power Supply.
- .43 VAV - Variable Air Volume.

1.4 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 5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54.

1.5 SYSTEM DESCRIPTION

- .1 The existing controls system at the Grand Valley Institute for Women (GVI) is required to be upgraded and the newer control systems that have been installed since the original construction integrated into a new Building Automation System. Scope of work to be completed by Contractor is as follows:
 - .1 Install new controls for Public Entrance Building and renovations within Wing A of the main GVI Building.
 - .2 Replace existing Barber-Colman Network 8000 controllers as indicated on mechanical drawings within the GVI facility.
 - .3 Replace existing sensors as indicated on mechanical drawings.
 - .4 Integrate additional control points indicated within drawings and specifications within the GVI campus onto the new BAS.
 - .5 Provide new OWS (software and hardware). OWS to be based on the Niagara Framework platform by Tridium.
 - .6 Integrate existing Institutional Food Services and Stores Building (IFSS) BAS onto the new BAS.
 - .1 Existing controllers and devices are to be reused.
 - .2 Contractor is to map existing points to new OWS
 - .3 Sequences and programming of the existing IFFS controllers is to remain as existing.
 - .4 The existing IFSS system is a Johnson Controls FX Supervisory controller operating on the Tridium Niagara Software using the BACnet IP communication protocol.
 - .7 This Contractor is permitted to reuse existing controllers and devices if such devices are able to be integrated into the new BAS. If such devices cannot be reliably integrated they must be replaced as part of this contract. Contractor to confirm in writing to Departmental Representative within 2 weeks of award of contract how the existing devices are proposed to be used within the new BAS and how they will be integrated. Contractor is to include price for replacement of existing controllers that are permitted to be reused at the time of bid submission if they are required to be replaced as part of the contractors proposed BAS.
 - .8 Building and systems must remain fully functional during controls replacement. All new controllers are to operate under stand alone control until such a time they can be reliable integrated onto the new BAS without interfering with the operation of the existing BAS. Coordinate equipment shut-downs with Departmental Representative. All controllers to be installed, programmed, tested, and operated to minimize equipment downtime.
 - .2 Refer to mechanical floor plans, mechanical schematics and details, Section 25 90 01 and individual sections referenced within for overview of system and further detail on individual components.
 - .3 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.
- .4 Design Requirements:
- .1 This division will be responsible for conductors and cables, and grounding and bonding associated with the installation of the control system that are consistent with project requirements and listed regulatory requirements.
 - .2 This division will be responsible for the following scope of work. This list is not exhaustive and it is the responsibility of the Contractor to ensure that all work defined within the Contract Documents and coordinated.
 - .1 All 24V or other low voltage wiring, conduit, final connections, junction boxes, etc. required for any mechanical device and for controls system.
 - .2 All 120V wiring, conduit, final connections, junction boxes, etc. required for any mechanical controls and system. Coordinate required circuits from available circuit panels with Division 26.
 - .3 Provide and install any/all 120V to 24V step down controllers required for control of mechanical systems.
 - .4 Mounting and programming of VFD drives. Line side power wiring is by Division 26.
 - .5 Reviewing all mechanical shop drawings that contain controllers to ensure that they will be compatible with BACnet based BAS and wiring design.
 - .3 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
 - .4 Existing control system is a Barber-Colman Network 8000 DDC BAS. All existing Barber-Colman controllers are to be replaced along with the existing operators work station (software and hardware). Contractor can re-use non-Barber-Colman controllers and gateways that have been added since the original construction at their own discretion. Contractor takes full responsibility for existing controllers if re-used and must provide a fully functioning system.
 - .5 Location of controllers as reviewed by Departmental Representative prior to installation.
 - .6 Provide utility power to EMCS as indicated. Coordinate with electrical contractor.
 - .7 Metric references: in accordance with CAN/CSA Z234.1 (withdrawn).
- .5 Language Operating Requirements:
- .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals. Other information to be in English.
-

- .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
- .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OWS utilities used for maintaining optimal operating efficiency.
- .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points.
 - .3 Point name expansions in both languages.
 - .4 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 and 25 05 02.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within 30 days after award of contract.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental 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 Departmental Representative.
 - .8 Existing devices intended for re-use: submit test report.

1.7 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 bid 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 36.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .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 Departmental Representative.
 - .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.9 EXISTING CONDITIONS - CONTROL COMPONENTS

- .1 Contractor is to utilize existing control wiring and piping if in good working order.
 - .2 Re-use field control devices that are usable in their original configuration.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
-

- .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Controls contractor is to re-use existing communication BUS' within Main GVI building for controls replacement.
 - .1 One BUS extends from ST-01 to the top floor of the Intensive Intervention Unit. This bus is a RS-485, shielded twisted wire (two wire) communication bus that is daisy chained from the GCM in ST-01 to all of the VAV box controllers and newer microzone controllers. Refer to mechanical drawings for system architecture schematic.
 - .2 A second BUS goes from ST-08, out to the Standard Living Environment (SLE), and back to ST-01 to connect to the GCM. This bus is a RS-485, shielded twisted wire (two wire) communication bus that is daisy chained to all of the local control modules LCM. Refer to mechanical drawings for system architecture schematic.
- .4 Inspect and test existing devices and wiring (communication bus) 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 Departmental Representative.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .5 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .6 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .7 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental 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.
- .8 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Data Communication Protocol: to ASHRAE STD 135.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

Part 3 EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Painting: in accordance with Section 09 91 99 , supplemented as follows:
- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
 - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.
 - .2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 Names of contractors and site-specific key personnel.
 - .5 Sketch of site-specific system architecture.
 - .6 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .7 Descriptive brochures.
 - .8 Sample CDL and graphics (systems schematics).
 - .9 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 and coordinate with requirements in this Section.
 - .2 Submit preliminary design document within 30 working days after contract award, for review by Departmental 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 Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.
-

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 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 Controller locations.
 - .4 Auxiliary control cabinet locations.
 - .5 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .6 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).
 - .7 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

1.6 DETAIL 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 Complete Point Name Lists.
 - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .6 Software and programming details associated with each point.
 - .7 Manufacturer's recommended installation instructions and procedures.
 - .8 Input and output signal levels or pressures where 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, 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.

1.7 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 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.
 - .2 Section 25 05 02 - EMCS: Submittals and Review Process.
 - .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00, supplemented and modified by requirements of this Section.
- .2 Submit As-built drawings and Operation and Maintenance Manual to Departmental Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 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.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 2 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
 - .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
 - .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
 - .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented 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.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.
 - .2 It is the intent of this section to have all new and existing devices, sensors, equipment, wiring and conduit that is associated with the EMCS, and is part of this work, to have the correct label and the label to be legible.
- .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-12, The Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01.

1.4 SYSTEM DESCRIPTION

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

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 supplemented and modified by requirements of this Section.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 PRODUCTS

2.1 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.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by 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.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: As indicated on mechanical drawings, confirmed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured 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 Departmental Representative.

2.5 WIRING

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

2.6 CONDUIT

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

Part 3 EXECUTION

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.
- .2 Do not label nameplates within inmate areas.

3.2 EXISTING PANELS, DEVICES AND EQUIPMENT

- .1 Correct existing nameplates and legends to reflect changes made during Work.
- .2 Existing equipment that retains its previous identifier but has an illegible nameplate or label shall be provided with a new nameplate and label so it can be easily identified in the field.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 25 05 01 - EMCS: General Requirements.
- .3 References.
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
 - .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
 - .3 Submit detailed inspection reports to Departmental Representative.
 - .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
 - .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
 - .6 Records and logs: in accordance with Section 01 78 00.
 - .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 Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide a 1 year warranty on parts, equipment and programming.
- .2 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .3 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 6 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .4 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .5 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .6 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental 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 each field input/output device in accordance with Canada Labour Code - Part I.
 - .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 Departmental Representative to discuss suggested or required changes.
 - .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
 - .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
-

- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).
- .2 Related Sections:
 - .1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA T568.1-05(R2010), Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements.
 - .2 CSA T530-99, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
 - .1 IEEE 802.3, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-2009, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
 - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
 - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568 and CSA T530, TIA/EIA-569-A and TBITS 6.9.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
-

- .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Network interface cards.
 - .3 Network management hardware and software.
 - .4 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 EMCS to utilize existing LAN within the buildings to connect to the new OWS. Coordinate with Departmental Representative for connection points to existing LAN and IP addresses.
 - .2 EMCS-LAN to: BACnet
 - .3 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
 - .4 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .5 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .6 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
 - .1 Network medium: compatible with network protocol to be used within existing building.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 23 81 40 – Air and Water Source Unitary Heat Pumps
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .4 Section 25 05 03 - EMCS: Project Record Documents.
 - .5 Section 25 30 02 - EMCS: Field Control Devices.
 - .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2011, Applications Handbook, SI Edition.
 - .2 ASHRAE STD 135-2012, BACnet - A Data Communication Protocol for Building Automation and Control Networks.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No.205-2012, Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1-2012, Standard for Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD 250005-2009 Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

- .1 Refer to Section 25 05 01 for overview of system and scope of work.
 - .2 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.
-

- .3 This division will be responsible for conductors and cables, and grounding and bonding associated with the installation of the control system that are consistent with project requirements and listed regulatory requirements.
- .4 This division will be responsible for the following scope of work. This list is not exhaustive and it is the responsibility of Contractor to ensure that all work defined within the Contract Documents and coordinated.
 - .1 All 24V or other low voltage wiring, conduit, final connections, junction boxes, etc. required for any mechanical device and for controls system.
 - .2 All 120V wiring, conduit, final connections, junction boxes, etc. required for any mechanical controls and system. Coordinate required circuits from available circuit panels with Division 26.
 - .3 Provide and install any/all 120V to 24V step down controllers required for control of mechanical systems.
 - .4 Mounting and programming of VFD drives. Line side power wiring is by Division 26.
 - .5 Reviewing all mechanical shop drawings that contain controllers to ensure that they will be compatible with BACnet based BAS and wiring design.
- .5 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
- .6 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
 - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- .7 Contractor is to re-use existing communication BUS' within Main GVI building for controls replacement. Refer to Section 25 05 01 for testing requirements of existing communication bus.
 - .1 One BUS extends from ST-01 to the top floor of the Intensive Intervention Unit. This bus is a RS-485, shielded twisted wire (two wire) communication bus that is daisy chained from the GCM in ST-01 to all of the VAV box controllers and newer microzone controllers. Refer to mechanical drawings for system architecture.
 - .2 A second BUS goes from ST-08, out to the Standard Living Environment (SLE), and back to ST-01 to connect to the GCM. This bus is a RS-485, shielded twisted wire (two wire) communication bus that is daisy chained to all of the local control modules LCM. Refer to mechanical drawings for system architecture.

- .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.
 - .6 Web accessible control program.
- .2 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
 - .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 – 20 mA;
 - .2 0 – 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
 - .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20mA.

- .2 0 - 10 V DC.
- .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .3 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .4 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door for controllers in public areas. Controllers mounted within mechanical rooms, electrical/communication rooms, or return air plenums, may be wall mounted without cabinets.
 - .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.
- .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .6 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 and Section 25 05 02.
 - .1 Submit product data sheets for each product item proposed for this project.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- .1 All project developed hardware and software shall become the property of PWGSC, including but not limited to project graphic images, record drawings, project database, job-specific application programming code, and all documentation
- .2 PWGSC shall be the named license holder of all software associate with any and all incremental work on the project. In addition, PWGSC shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project.
- .3 Any and all required ID's and passwords for access to any component of software program shall be provided to the Departmental Representative.

- .4 The Departmental Representative shall determine which organizations to be named in the System Installer (SI) organization ID (orgid) of all software licenses. The Departmental Representative shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

1.8 MAINTENANCE PROCEDURES

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03.

Part 2 PRODUCTS

2.1 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- .1 The intent of this specification it to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2012 BACnet communication protocol into an open interoperable system.
- .2 The supplied computer software shall employ object-oriented technology for representation of all data and control devices within the system. All supplied devices must be BACnet Testing Laboratories listed. Physical connections of BACnet devices shall be via BACnet/IP and or BACnet MS/TP (RS-485) as specified.
- .3 All components and controllers supplied under this division shall be true “peer-to-peer communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
- .4 The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. Systems requiring proprietary database and user interface programs shall not be acceptable.
- .5 A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the Owner’s internal intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.
- .1 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for local network connected user devices.

2.2 OWS HARDWARE

- .1 PC system to include:
- .1 Processor: micro-processor, operating at minimum clock speed of 4 Gigahertz, capable of supporting software necessary to perform functions specified in this section. System backplane bus (100 Megahertz) to support PCI and ISA boards.
- .2 Internal clock.
- .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
- .2 Rechargeable batteries: to provide minimum 48 h clock operation in event of power failure.
-

- .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
- .2 Power supply unit to accept 120 V, 60 Hz source and include line surge and low voltage protection for processor and its peripherals.

2.3 OWS PC COMPONENTS

- .1 Primary OWS: PC compatible with following as minimum:
 - .1 IDE Disk drive controller to support 4 drives.
 - .1 1- 1 TB hard disk drive.
 - .2 1- 48X/24X/48X DVD-RW/CD-RW combo drive.
 - .2 512 MB RAM minimum.
 - .3 Keyboard.
 - .4 USB mouse.
 - .5 2 colour monitors: 21" minimum each. Flat panel display TFT, resolution 1280 X 1040, dot pitch 0.26 mm, colour support 24 bit,
 - .6 Video card with 128 MB video RAM, dual monitor native support.
 - .7 2-front USB and 4-rear USB connection slots.
 - .8 Include two 2 spare expansion slots in system for PWGSC's use.
 - .9 PCI Ethernet LAN Adapter to connect to local Ethernet LAN network.
 - .10 600 W minimum power supply.

2.4 OPERATING SYSTEM (OS) OR EXECUTIVE

- .1 OS to support complement of hardware terminals and software programs specified.
- .2 OS to be true multitasking operating environment.
 - .1 MS DOS or PC DOS based software platforms not permitted.
- .3 OWS software to operate in "Windows" based operating environment.

2.5 OWS CONTROL SOFTWARE

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
- .2 The operators workstation shall be fitted with the Supervisor AX software from Tridium for central control and archiving.
- .3 Time Synchronization Module.
 - .1 System to provide Time Synchronization of real-time clocks in controllers.
 - .2 System to perform this feature on regular scheduled basis and on operator request.
- .4 User Display Interface Module.
 - .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.

- .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking or different colour, to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.
 - .5 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
 - .1 Operator Log-in from user interface device.
 - .2 Communication messages: errors, failures and recovery.
 - .3 Event notifications and alarms by category.
 - .4 Record of operator initiated commands.
 - .6 General Event Log:
 - .1 Hold minimum of 4 months information and be readily accessible to operator.
 - .2 Able to be archived as necessary to prevent loss of information.
 - .7 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
 - .1 Automatic logging of digital alarms and change of status messages.
 - .2 Automatic logging of analog alarms.
 - .3 System changes: alarm limits, set-points, alarm lockouts.
 - .4 Display specific point values, states as selected.
 - .5 Provide reports as requested and on scheduled basis when required.
 - .6 Display graphics as requested, and on alarm receptions (user's option).
 - .7 Display list of points within system.
 - .8 Display list of systems within building.
 - .9 Direct output of information to selected peripheral device.
 - .10 On-line changes:
 - .1 Alarm limits.
 - .2 Setpoints.
 - .3 Deadbands.
 - .4 Control and change of state changes.
 - .5 Time, day, month, year.
 - .6 Control loop configuration changes for controller-based CDLs.
 - .7 Control loop tuning changes.
 - .8 Schedule changes.
-

- .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
 - .11 According to assigned user privileges (password definition) following functions are to be supported:
 - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
 - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
 - .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
 - .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
 - .1 Message and alarm buffering to prevent loss of information.
 - .2 Error detection correction and retransmission to guarantee data integrity.
 - .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.
 - .4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.
 - .9 Access ControlModule.
 - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
 - .1 Guest: no password data access and display only.
 - .2 Operator Level: full operational commands including automatic override.
 - .3 Technician: data base modifications.
 - .4 Programmer: data base generation.
 - .5 Highest Level : system administration - password assignment addition, modification.
 - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 30 minutes.
 - .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
 - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 1 month capacity on local controller and backed up on OWS for a period of 2 years.
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- .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 600 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 h basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.
- .3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.
- .4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.
- .5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.
- .11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level.
 - .1 Reports to include time, day, month, year, report title, operator's initials.
 - .2 Software to provide capability to:
 - .1 Generate and format reports for graphical and numerical display from real time and stored data.
 - .2 Print and store reports as selected by operator.
 - .3 Select and assign points used in such reports.
 - .4 Sort output by area, system, as minimum.
 - .3 Periodic/automatic report:
 - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
 - .2 Reports to include:
 - .1 Power demand and duty cycle summary: see application program for same.
 - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.

- .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
 - .4 Summary of run time alarms: include point name, run time to date, alarm limit.
 - .5 Summary of start/stop schedules: include start/stop times and days, point name.
 - .6 Motor status summary.
 - .4 Report types:
 - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
 - .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
 - .3 Area (points and systems in Area).
 - .4 Area, system (points in system).
 - .5 System (points by system type).
 - .6 System point (points by system and point object type).
 - .7 Area point (points by system and point object type).
 - .8 Point (points by point object type).
 - .5 Summary report: printout or display of point object data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
 - .6 Include preformatted reports as listed in Event/Alarm Module.
 - .12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01.
 - .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
 - .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
 - .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.
 - .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
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- .1 Modify portion of graphic picture/schematic background.
 - .2 Delete graphic picture.
 - .3 Call up and cancel display of graphic picture.
 - .4 Define symbols.
 - .5 Position and size symbols.
 - .6 Define background screens.
 - .7 Define connecting lines, curves.
 - .8 Locate, orient, size descriptive text.
 - .9 Define, display colours of elements.
 - .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
- .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
- .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
- .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress.
- .8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Departmental Representative. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and , flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Departmental Representative to provide CAD floor layouts. Provide display of TCU -VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.
- .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.
- .10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English language.
- .13 Event/Alarm Module : displays in window alarms as received and stored in General Event Log.

- .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
- .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
- .3 Alarm reports.
 - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
 - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
 - .3 Summary of alarm messages: include associated point name, alarm description.
- .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
- .5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
 - .1 Critical – 5 seconds.
 - .2 Cautionary - 10 seconds.
 - .3 Maintenance – 10 seconds.
- .6 Display alarm messages in English.
- .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
- .8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgment of one alarm as acknowledgement of other alarms.
- .9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
 - .1 Controller not responding - where possible delineate between controller and communication line failure.
 - .2 Controller responding - return to normal.
 - .3 Controller communications bad - high error rate or loss of communication.
 - .4 Controller communications normal - return to normal.

- .10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.
- .14 Archiving and Restoration Module.
 - .1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
 - .2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
 - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .15 CDL Generator and Modifier Module.
 - .1 CDL Generator module to permit generation and modification of CDLs.
 - .2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.
 - .3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.
 - .4 Module to permit testing of code before downloading to building controllers.

2.6 WEB BROWSER CLIENTS

- .1 The system shall be capable of supporting an unlimited number of clients using a standard Web browser. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- .2 The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the EMCS, shall not be acceptable.
- .3 The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- .4 The Web browser client shall support at a minimum, the following functions:
 - .1 User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

- .2 Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
- .3 HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
- .4 Storage of the graphical screens shall be in the MCU, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
- .5 Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
- .6 Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - .1 Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - .2 Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - .3 Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - .4 Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - .5 View logs and charts
 - .6 View and acknowledge alarms
 - .7 Setup and execute SQL queries on log and archive information
- .5 The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator

2.7 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 MCU must be C-UL listed to CSA and shall be BACnet Testing Laboratory listed.
- .3 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must communicate in BACnet / IP.
- .4 Master Control unit to be web-accessible and embedded with Niagara Frameworks by Tridium.
- .5 MCU local I/O capacity as follows:
 - .1 MCU I/O points as allocated in I/O Summary Table referenced in Section 25 90 01.

- .2 LCUs may be added to support system functions.
- .6 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.

2.8 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.

2.9 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
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- .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 Controls contractor to provide TCU/ECU controller and actuators to terminal equipment manufacturer for factory mounting.
- .4 Constant Volume Bypass Terminal and Variable Volume Terminal Controllers.
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer, control modulating two-way heating valve, and measure temperatures as per I/O Summary required inputs. Air flow control to be pressure independent.
 - .2 Controller to support point definition; in accordance with Section 25 05 01.
 - .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. Actuator to be 24V reversible type. Factory mount actuator direct to the damper shaft. Actuator to have an adjustable end-stop.
 - .5 Sequence of operation as indicated in Section 25 90 01.

2.10 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 1place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.11 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01.

Part 3 EXECUTION

3.1 LOCATION

- .1 Refer to mechanical drawings for location of existing controllers. Replacement controllers shall be in the same location as the controllers they are replacing. Any new controllers added to integrate new equipment shall be installed in a location similar to the controllers serving similar equipment within the system. Final mounting locations of new controllers to be approved by Departmental Representative.
- .2 Location of controllers for the Public Entrance Building to be within Mechanical Room A202. Final mounting locations within room to be approved by Departmental Representative.

3.2 INSTALLATION

- .1 Install Controllers in secure locking enclosures.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment including conduit, junction boxes, labour, and accessories. Coordinate exact power requirements with Division 26.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Provide for the installation and mapping of points from manufacturer's supplied gateway(s) for VRF system as specified in Section 23 81 40. Gateway to be accessible from OWS.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .4 Section 25 05 54 - EMCS: Identification.
 - .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .6 Section 26 05 00 - Common Work Results - Electrical.
 - .7 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-2005, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-08, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(R2009), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-2012, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02.
 - .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
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- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

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

Part 2 PRODUCTS

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, vibration-proof assembly.
- .3 Operating conditions: 0 - 32°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.

2.2 TEMPERATURE SENSORS AND THERMOSTATS

- .1 General: To be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm °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°C.

- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length to be half of pipe diameter.
- .7 Temperature sensors provided in inmate accessible areas to be provided with protective wire guard cover.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and wall module.
 - .1 Jack connection for plugging in laptop personal computer for access to field adjustments of damper ranges, user adjustable set-point range, unoccupied set-points, as well as PI tuning variables.
 - .2 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .3 Accuracy 0.2°C over range of 0 to 70°C.
 - .4 Stability 0.02°C drift per year.
 - .5 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum finish.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2°C.
 - .3 Constant Volume Bypass Box Thermostat
 - .1 24 volt modulating electronic thermostat.
 - .2 Jack connection for plugging in laptop personal computer for access to field adjustments of damper ranges, user adjustable set-point range, unoccupied set-points, as well as PI tuning variables.
 - .3 Thermostat to be capable of supporting analogy modulating auxiliary heat
 - .4 Variable Volume Diffusers
 - .1 Wall mounting, in slotted type covers having brushed aluminum finish.
 - .5 VRF equipment thermostats
 - .1 Wall mounted thermostats for controlling VRF indoor units to be provided by VRF equipment manufacturer and installed by Division 25.
 - .6 VRF equipment temperature sensors.
 - .1 Wall mounted temperature sensors for controlling VRF indoor units to be provided by VRF equipment manufacturer and installed by Division 25.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length as required to measure temperature from centre of duct.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 600 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.
- .5 Remote Bulb Thermostat:
 - .1 Line Voltage remote bulb type thermostat with:
 - .1 30A rating at 120V
 - .2 Copper capillary tube, length to suit site installation.
 - .3 Cast weather tight box.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01°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/ 50°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°C, plus or minus 0.5°C.
 - .2 0 to 100°C, plus or minus 0.5°C.
 - .3 0 to 50°C, plus or minus 0.25°C.
 - .4 0 to 25°C, plus or minus 0.1°C.
 - .5 10 to 35°C, plus or minus 0.25 °C.

2.4 HUMIDITY SENSORS

- .1 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%.
 - .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 Duct mounted sensors: locate so that sensing element is in air flow in duct, 3m downstream of steam dispersion device.
- .2 Outdoor Humidity Requirements:
 - .1 Range: 0 - 100% RH minimum.
 - .2 Operating temperature range: -40°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.

2.5 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.

2.6 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°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.

2.7 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°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.

2.8 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.

2.9 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 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

- .7 Switches on high temperature hot water service: provide pigtail syphon.

2.11 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: 120V, 15 amps as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Duct, general purpose: insertion length = 460 mm.
 - .2 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .3 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .4 Strap-on: with helical screw stainless steel clamp.

2.12 SUMP LEVEL SWITCHES

- .1 Requirements:
 - .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
 - .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
 - .3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

2.13 AIR PRESSURE GAUGES

- .1 Diameter: 38 mm minimum.
- .2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.14 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 120V AC.
 - .4 Relay to have visual status indication

2.15 SOLID STATE RELAYS

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator.

- .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
- .4 Operating temperature range to be -20°C to 70°C.
- .5 Relays to be CSA Certified.
- .6 Input/output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.
- .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.16 CURRENT TRANSDUCERS

- .1 Requirements:
 - .1 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
 - .2 Frequency insensitive from 10 - 80 hz.
 - .3 Accuracy to 0.5% full scale.
 - .4 Zero and span adjustments. Field adjustable range to suit motor applications.
 - .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.17 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.

2.18 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.

- .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
 - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
 - .3 Bearings: maintenance free, synthetic type of material.
 - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
 - .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25 L/s/m² maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
 - .3 Temperature range: minus 30°C to plus 40°C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.
 - .4 Use same manufacturer as damper sections.

2.19 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.

2.20 CONTROL VALVES

- .1 Body: globe style.
 - .1 Flow characteristic to suit coil application.

- .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
- .3 Normally open
- .4 Two port, as indicated.
- .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
- .6 Packing easily replaceable.
- .7 Stem, stainless steel.
- .8 Plug and seat, stainless steel, brass
- .9 Disc, replaceable, material to suit application.
- .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
 - .3 Rangeability 50:1 minimum.
- .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
 - .1 Body: ANSI Class 150 cast iron installed in locations as indicated.
 - .2 End connections to suit flanges that are ANSI Class 150.
 - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
 - .4 Pressure limit: bubble tight sealing to 170 kilopascals.
 - .5 Disc/vane: 316 stainless steel.
 - .6 Seat: PTFE (polytetrafluoroethylene)
 - .7 Stem: 316 stainless steel.
 - .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .9 Flow characteristic linear.
 - .10 Maximum flow requirement as indicated on control valve schedule.
 - .11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
 - .12 Normally open, as indicated.
 - .13 Valves are to be provided complete with mounting plate for installation of actuators.

2.21 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.

- .6 Size actuator to meet requirements and performance of control valve specifications.
- .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
- .8 Minimum shut-off pressure: refer to control valve schedule.

2.22 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.23 WIRING

- .1 In accordance with Section 26 27 26.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded #18 minimum solid copper.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, 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. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

- .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .4 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(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.
- .5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 Mechanical: supply and install in accordance with Section 23 05 05.
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.
- .8 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.

3.2 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.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
- .2 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.6 AIR PRESSURE GAUGES

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.7 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54.

3.8 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.9 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 A description of the existing system to be upgraded and the new system to be installed.
 - .2 The existing system (GVI Facility) indicates the existing points that are currently installed in each LCM, and a complete point list that is to be incorporated into the new operators work station.
 - .3 The new system (PEB) description includes the following:
 - .1 Input/Output Point Summary Tables for each system.
 - .2 Sequence of operations for each system.

1.2 REFERENCES

- .1 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD 250005-2009 Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.3 RELATED SECTIONS

- .1 Section 23 37 13 – Diffusers, Registers and Grilles
- .2 Section 23 81 40 – Air and Water Source Unitary Heat Pumps
- .3 Section 23 82 20 – Forced Air Heaters
- .4 Section 23 25 00 – HVAC Water Treatment Systems
- .5 Section 23 73 11 – Air Handling Units - Packaged
- .6 Section 23 52 00 – Heating Boilers
- .7 Section 23 21 23 – Hydronic Pumps
- .8 Section 22 30 05 – Domestic Water Heaters
- .9 Section 23 65 10 – Condensers, Coolers, and Cooling Towers
- .10 Section 23 84 13 – Humidifiers
- .11 Section 25 05 54 – EMCS: Identification

1.4 GVI FACILITY EXISTING LCM POINT SUMMARY

- .1 This sub-section includes the existing physical point connections for the various controllers located throughout the facility. The Contractor is responsible for replacing the existing controllers as noted on the drawings at a minimum, or as required for the proposed system, to obtain a fully function EMCS.

- .2 The Contractor is responsible for reviewing the existing controller point descriptions as well as new control points in Section 1.5 and the sequences of operation in Section 1.7. For clarity only the existing points are included in the existing controller I/O point tables. Soft points for OWS functionality are described within the sequences of operation. The Contractor is responsible for ensuring the new controllers accommodate the existing points, the new points, and achieve the intent of the sequences of operation for the existing GVI Facility.
- .3 Where equipment tags appear in brackets (), this is meant to indicate the existing tag of the equipment that will be found onsite. The drawings included with this specification will have the same labeling logic. Contractor is to re-label this equipment to correspond with the new equipment tag. Refer to Section 25 05 54 for further details.
- .4 The following are the existing Barber-Colman controllers.
- .1 The following is a list of the existing VAV controllers within the GVI Facility that require replacement.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
VAV-1	Room A116 Temperature	AI	N	Y	DEGREE C
VAV-1	VAV Box 1 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-1	VAV Box 1 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-1	VAV Box 1 Current Flow	AI	N	Y	L/S
VAV-1	VAV Box 1 Max Flow	AI	N	N	L/S
VAV-1	VAV Box 1 Min Flow	AI	N	N	L/S
VAV-1	VAV Box 1 Damper Command	AI	N	Y	0-100%
VAV-1	VAV Box 1 Heating Valve Command	AI	N	Y	0-100%
VAV-2	Room A125 Temperature	AI	N	Y	DEGREE C
VAV-2	VAV Box 2 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-2	VAV Box 2 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-2	VAV Box 2 Current Flow	AI	N	Y	L/S
VAV-2	VAV Box 2 Max Flow	AI	N	N	L/S
VAV-2	VAV Box 2 Min Flow	AI	N	N	L/S
VAV-2	VAV Box 2 Damper	AI	N	Y	0-100%

	Command				
VAV-2	VAV Box 2 Heating Valve Command	AI	N	Y	0-100%
VAV-3	Room A136 Temperature	AI	N	Y	DEGREE C
VAV-3	VAV Box 3 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-3	VAV Box 3 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-3	VAV Box 3 Current Flow	AI	N	Y	L/S
VAV-3	VAV Box 3 Max Flow	AI	N	N	L/S
VAV-3	VAV Box 3 Min Flow	AI	N	N	L/S
VAV-3	VAV Box 3 Damper Command	AI	N	Y	0-100%
VAV-3	VAV Box 3 Heating Valve Command	AI	N	Y	0-100%
VAV-4	Room A105 Temperature	AI	N	Y	DEGREE C
VAV-4	VAV Box 4 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-4	VAV Box 4 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-4	VAV Box 4 Current Flow	AI	N	Y	L/S
VAV-4	VAV Box 4 Max Flow	AI	N	N	L/S
VAV-4	VAV Box 4 Min Flow	AI	N	N	L/S
VAV-4	VAV Box 4 Damper Command	AI	N	Y	0-100%
VAV-4	VAV Box 4 Heating Valve Command	AI	N	Y	0-100%
VAV-5	Room A141 Temperature	AI	N	Y	DEGREE C
VAV-5	VAV Box 5 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-5	VAV Box 5 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-5	VAV Box 5 Current Flow	AI	N	Y	L/S

VAV-5	VAV Box 5 Max Flow	AI	N	N	L/S
VAV-5	VAV Box 5 Min Flow	AI	N	N	L/S
VAV-5	VAV Box 5 Damper Command	AI	N	Y	0-100%
VAV-5	VAV Box 5 Heating Valve Command	AI	N	Y	0-100%
VAV-6	Room A155 Temperature	AI	N	Y	DEGREE C
VAV-6	VAV Box 6 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-6	VAV Box 6 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-6	VAV Box 6 Current Flow	AI	N	Y	L/S
VAV-6	VAV Box 6 Max Flow	AI	N	N	L/S
VAV-6	VAV Box 6 Min Flow	AI	N	N	L/S
VAV-6	VAV Box 6 Damper Command	AI	N	Y	0-100%
VAV-6	VAV Box 6 Heating Valve Command	AI	N	Y	0-100%
VAV-7	Room B105 Temperature	AI	N	Y	DEGREE C
VAV-7	VAV Box 7 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-7	VAV Box 7 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-7	VAV Box 7 Current Flow	AI	N	Y	L/S
VAV-7	VAV Box 7 Max Flow	AI	N	N	L/S
VAV-7	VAV Box 7 Min Flow	AI	N	N	L/S
VAV-7	VAV Box 7 Damper Command	AI	N	Y	0-100%
VAV-7	VAV Box 7 Heating Valve Command	AI	N	Y	0-100%
VAV-7	VAV Box 7 Radiation Valve Command	AI	N	Y	0-100%
VAV-8	Room B115 Temperature	AI	N	Y	DEGREE C
VAV-8	VAV Box 8 Cooling Temperature Setpoint	AO	N	N	DEGREE C

VAV-8	VAV Box 8 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-8	VAV Box 8 Current Flow	AI	N	Y	L/S
VAV-8	VAV Box 8 Max Flow	AI	N	N	L/S
VAV-8	VAV Box 8 Min Flow	AI	N	N	L/S
VAV-8	VAV Box 8 Damper Command	AI	N	Y	0-100%
VAV-8	VAV Box 8 Heating Valve Command	AI	N	Y	0-100%
VAV-8	VAV Box 8 Radiation Valve Command	AI	N	Y	0-100%
VAV-9	Room B117 Temperature	AI	N	Y	DEGREE C
VAV-9	VAV Box 9 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-9	VAV Box 9 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-9	VAV Box 9 Current Flow	AI	N	Y	L/S
VAV-9	VAV Box 9 Max Flow	AI	N	N	L/S
VAV-9	VAV Box 9 Min Flow	AI	N	N	L/S
VAV-9	VAV Box 9 Damper Command	AI	N	Y	0-100%
VAV-9	VAV Box 9 Heating Valve Command	AI	N	Y	0-100%
VAV-9	VAV Box 9 Radiation Valve Command	AI	N	Y	0-100%
VAV-10	Room B124 Temperature	AI	N	Y	DEGREE C
VAV-10	VAV Box 10 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-10	VAV Box 10 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-10	VAV Box 10 Current Flow	AI	N	Y	L/S
VAV-10	VAV Box 10 Max Flow	AI	N	N	L/S
VAV-10	VAV Box 10 Min Flow	AI	N	N	L/S
VAV-10	VAV Box 10 Damper Command	AI	N	Y	0-100%

VAV-10	VAV Box 10 Heating Valve Command	AI	N	Y	0-100%
VAV-11	VAV Box 11 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-11	VAV Box 11 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-11	VAV Box 11 Current Flow	AI	N	Y	L/S
VAV-11	VAV Box 11 Max Flow	AI	N	N	L/S
VAV-11	VAV Box 11 Min Flow	AI	N	N	L/S
VAV-11	VAV Box 11 Damper Command	AI	N	Y	0-100%
VAV-11	VAV Box 11 Heating Valve Command	AI	N	Y	0-100%
VAV-12	Room B141 Temperature	AI	N	Y	DEGREE C
VAV-12	VAV Box 12 Cooling Temperature Setpoint	AO	N	N	DEGREE C
VAV-12	VAV Box 12 Heating Temperature Setpoint	AO	N	N	DEGREE C
VAV-12	VAV Box 12 Current Flow	AI	N	Y	L/S
VAV-12	VAV Box 12 Max Flow	AI	N	N	L/S
VAV-12	VAV Box 12 Min Flow	AI	N	N	L/S
VAV-12	VAV Box 12 Damper Command	AI	N	Y	0-100%
VAV-12	VAV Box 12 Heating Valve Command	AI	N	Y	0-100%

.2 Existing LCM-01 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AHU-1	Outside Air Temperature	AI	N	Y	DEGREE C	P01
AHU-1	Supply Air Temperature	AI	N	Y	DEGREE C	P02
AHU-1	Supply Air % Relative Humidity	AI	N	Y	% RH	P03
AHU-1	Mixed Air Temperature	AI	N	Y	DEGREE C	P04
AHU-1	Return Air Temperature	AI	N	Y	DEGREE C	P05

AHU-1	Return Air % Relative Humidity	AI	N	Y	% RH	P06
AHU-1	Differential Static Pressure Sensor	AI	N	Y	PASCAL	P07
AHU-1	Supply Air Flow	AI	N	Y	L/S	P08
AHU-1	Return Air Flow	AI	N	Y	L/S	P09
AHU-1	Heating Control Valve 1	AO	N	Y	0-100%	P10
AHU-1	Mixed Air Damper Control	AO	N	Y	0-100%	P11
AHU-1	Humidifier Output	AO	N	Y	0-100%	P12
AHU-1	Supply Fan VFD Output	AO	N	Y	0-100%	P13
AHU-1	Return Fan VFD Output	AO	N	Y	0-100%	P14
AHU-1	Freeze Stat	DI	Y	N	ALARM/NORMAL	P15
AHU-1	Alarm	DI	Y	N	ALARM/NORMAL	P16

.3 Existing LCM-02 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AHU-1	Supply Fan Status	DI	N	Y	ON/OFF	P01
AHU-1	Return Fan Status	DI	N	Y	ON/OFF	P02
AHU-1	Smoke Detector 1	DI	Y	N	ALARM/NORMAL	P03
AHU-1	Smoke Detector 2	DI	Y	N	ALARM/NORMAL	P04
RAD-1	Radiation A154 Control Valve	AI	N	Y	0-100%	P05
RAD-1	Radiation A154 Space Temperature	AI	N	Y	DEGREE C	P06
RAD-1	Radiation A154 Temperature Setpoint	AO	N	N	DEGREE C	P07
	Not Used					P08
AHU-1	Return Fan Enable	DO	Y	N	ON/OFF	P09
AHU-1	Heating Enable	DO	N	N	ON/OFF	P10
AHU-1	Supply Fan Enable	DO	N	Y	ON/OFF	P11
AHU-1	Return Fan Enable	DO	N	Y	ON/OFF	P12
AHU-1	DX Cooling Compressor 1 Enable	DO	N	Y	ON/OFF	P13
AHU-1	DX Cooling Compressor 2 Enable	DO	N	Y	ON/OFF	P14
	Not used					P15
	Not Used					P16

.4 Existing LCM-03 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AHU-2	Supply Air Temperature Sensor	AI	N	Y	Degree C	P01
AHU-2	Mix Air Temperature Sensor	AI	Y	Y	Degree C	P02
AHU-2	Return Air Temperature Sensor	AI	N	Y	Degree C	P03
AHU-2	Space Temperature	AI	N	Y	Degree C	P04
AHU-2	Mixed Air Damper Command	AO	N	Y	0-100%	P05
AHU-2	Heating Coil Control Valve CV-2 Command	AO	N	Y	0-100%	P06
AHU-2	Supply Air Flow Switch	DI	Y	Y	FLOW/NO FLOW	P07
AHU-2	Return Air Flow Switch	DI	Y	Y	FLOW/NO FLOW	P08
AHU-2	Freeze Stat	DI	Y	N	ALARM/NORMAL	P09
AHU-2	Smoke Detector 3	DI	Y	N	ALARM/NORMAL	P10
	Not Used					P11
	Not Used					P12
	Not Used					P13
AHU-2	Heating Enable	DO	N	N	ON/OFF	P14
AHU-2	Supply Fan Enable	DO	N	Y	ON/OFF	P15
AHU-2	Return Fan Enable	DO	N	Y	ON/OFF	P16

.5 Existing LCM-04 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AHU-3	Supply Air Temperature	AI	N	Y	DEGREE C	P01
AHU-3	Mix Air Temperature	AI	N	Y	DEGREE C	P02
AHU-3	Return Air Temperature	AI	N	Y	DEGREE C	P03
AHU-3	Space Temperature	AI	N	Y	Degree C	P04
AHU-3	Carbon Dioxide Sensor	AI	Y	Y	PPM	P05
AHU-3	Mixed Air Damper Command	AO	N	Y	0-100%	P06
AHU-3	Heating Control Valve, CV-3, Command	AO	N	Y	0-100%	P07
AHU-3	Supply Air Flow Switch	DI	Y	Y	FLOW/NO FLOW	P08

AHU-3	Return Air Flow Switch	DI	Y	Y	FLOW/NO FLOW	P09
AHU-3	Freeze Stat	DI	Y	N	ALARM/NORMAL	P10
AHU-3	Smoke Detector 4	DI	Y	N	ALARM/NORMAL	P11
	Not Used					P12
	Not Used					P13
AHU-3	Heating Enable	DO	N	N	ON/OFF	P14
AHU-3	Supply Fan Enable	DO	N	N	ON/OFF	P15
AHU-3	Return Fan Enable	DO	N	N	ON/OFF	P16

.6 Existing LCM-05 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	Room A120 Temperature	AI	N	Y	Degree C	P01
	Room A120 Temperature Setpoint	AO	N	Y	Degree C	P02
UH-1	UH-1 Status	DI	N	Y	ON/OFF	P03
UH-2	UH-2 Status	DI	N	Y	ON/OFF	P04
UH-3	UH-3 Status	DI	N	Y	ON/OFF	P05
UH-4	UH-4 Status	DI	N	Y	ON/OFF	P06
UH-9	UH-9 Enable	DO	N	N	ON/OFF	P07
UH-10	UH-10 Status	DI	N	Y	ON/OFF	P08
UH-11	UH-11 Status	DI	N	Y	ON/OFF	P09
EF-12	EF-12 Status	DI	N	Y	ON/OFF	P10
EF-13	EF-13 Status	DI	N	Y	ON/OFF	P11
	Room A121 Temperature	AI	N	Y	Degree C	P12
	Room A121 Temperature Setpoint	AO	N	Y	Degree C	P13
UH-12	UH-12 Status	DI	N	Y	ON/OFF	P14
EF-12	EF-12 Enable / UH-12 Enable	DO	N	N	ON/OFF	P15
EF-13	EF-13 Enable / UH-9 Enable	DO	N	N	ON/OFF	P16

.7 Existing LCM-06 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
UH-13	Room B123 Temperature	AI	N	Y	DEGREE C	P01
UH-13	Room B123 Temperature Setpoint	AO	N	N	DEGREE C	P02

EF-7	Room C169 Temperature	AI	N	Y	DEGREE C	P03
EF-7	Room C169 Temperature Setpoint	AO	N	N	DEGREE C	P04
RH-3	Room C202 Temperature	AI	N	Y	DEGREE C	P05
RH-3	RH-3 Control Valve Command	AO	N	Y	0-100%	P06
EF-5	EF-5 Status	DI	N	Y	ON/OFF	P07
Manifold 1	C169 Floor Heating	DO	N	Y	ON/OFF	P08
EF-15	EF-15 Status	DI	N	Y	ON/OFF	P09
EF-8	EF-5 Status	DI	N	Y	ON/OFF	P10
UH-5	UH-5 Status	DI	N	Y	ON/OFF	P11
EF-5	EF-5 Enable / UH-13	DO	N	N	ON/OFF	P12
EF-7	EF-7 Enable	DO	N	N	ON/OFF	P13
EF-8	EF-8 Enable	DO	N	N	ON/OFF	P14
EF-15	EF-15 Enable	DO	N	N	ON/OFF	P15
EF-13	EF-13 Enable	DO	N	N	ON/OFF	P16

.8 Existing LCM-07 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
EF-4 / UH-14	Room C161 Space Temperature	AI	N	Y	DEGREE C	P01
EF-4 / UH-14	Room C161 Temperature Setpoint	AO	N	Y	DEGREE C	P02
EF-19	Room C151 Space Temperature	AI	N	Y	DEGREE C	P03
EF-19	Room C151 Temperature Setpoint	AO	N	Y	DEGREE C	P04
RH-4	Room C210 Space Temperature	AI	N	Y	DEGREE C	P05
RH-7	Room C148 Space Temperature	AI	N	Y	DEGREE C	P06
RH-4	RH-4 Control Valve Command	AO	N	Y	0-100%	P07
RH-7	RH-7 Control Valve Command	AO	N	Y	0-100%	P08
EF-6	EF-6 Status	DI	N	Y	ON/OFF	P09
EF-19	EF-19 Status	DI	N	Y	ON/OFF	P10
EF-14	EF-14 Status	DI	N	Y	ON/OFF	P11
	Override Gym Light	DI	N	N	ON/OFF	P12

	Gym Light Enable	DO	N	Y	ON/OFF	P13
EF-4 / UH-14	EF-4 and UH-14 Enable	DO	N	N	ON/OFF	P14
EF-19	EF-19 Enable	DO	N	N	ON/OFF	P15
EF-14	EF-14 Enable	DO	N	N	ON/OFF	P16

.9 Existing LCM-08 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	Not Used					P01
Boilers	Hot Water Supply Temperature	AI	N	Y	DEGREE C	P02
Boilers	Hot Water Return Temperature	AI	N	Y	DEGREE C	P03
Boilers	Differential Pressure	AI	N	Y	kPA	P04
Boilers	CV-9 Bypass Valve Command	AO	N	Y	0-100%	P05
Boilers	Boiler 1 Status	DI	N	Y	ON/OFF	P06
Boilers	Boiler 2 Status	DI	N	Y	ON/OFF	P07
Boilers	Boiler 3 Status	DI	N	Y	ON/OFF	P08
Boilers	Pump 1 Status	DI	N	Y	ON/OFF	P09
Boilers	Pump 2 Status	DI	N	Y	ON/OFF	P10
UH-8	UH-8 Status	DI	N	Y	ON/OFF	P11
	Not Used					P12
	Not Used					P13
Boilers	Boiler Enable	DO	N	N	ON/OFF	P14
P-1	Pump P1 Enable	DO	N	N	ON/OFF	P15
P-2	Pump P2 Enable	DO	N	N	ON/OFF	P16

.10 Existing LCM-09 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
EF-9 / UH-7	Room C218 Space Temperature	AI	N	Y	DEGREE C	P01
EF-9 / UH-7	Room C218 Temperature Setpoint	AO	N	Y	DEGREE C	P02
EF-17	Room C127 Space Temperature	AI	N	Y	DEGREE C	P03
EF-17	Room C127 Temperature Setpoint	AO	N	Y	DEGREE C	P04
EF-9	EF-9 Status	DI	N	Y	ON/OFF	P05
EF-17	EF-17 Status	DI	N	Y	ON/OFF	P06
EF-4	EF-4 Status	DI	N	Y	ON/OFF	P07

EF-11	EF-11 Status	DI	N	Y	ON/OFF	P08
EF-16	EF-16 Status	DI	N	Y	ON/OFF	P09
	Not Used					P10
EF-9	EF-9 Enable	DO	N	N	ON/OFF	P11
EF-4	EF-4 Enable	DO	N	N	ON/OFF	P12
EF-11	EF-11 Enable	DO	N	N	ON/OFF	P13
EF-16	EF-16 Enable	DO	N	N	ON/OFF	P14
EF-17	EF-17 Enable	DO	N	N	ON/OFF	P15
EF-7	EF-7 Enable	DO	N	N	ON/OFF	P16

.11 Existing LCM-10 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
EF-10	Room A201 Space Temperature	AI	N	Y	DEGREE C	P01
EF-10	Room A201 Space Temperature Setpoint	AO	N	Y	DEGREE C	P02
RH-1	Room A151 Space Temperature	AI	N	Y	DEGREE C	P03
RH-2	Room A155 Space Temperature	AI	N	Y	DEGREE C	P04
RH-1	Reheat Coil RH-1 Actuator	AO	N	Y	0-100%	P05
RH-2	Reheat Coil RH-2 Actuator	AO	N	Y	0-100%	P06
EF-10	EF-10 Status	DI	N	Y	ON/OFF	P07
	Not Used					P08
EF-1	EF-1 Status	DI	N	Y	ON/OFF	P09
EF-18	EF-18 Status	DI	N	Y	ON/OFF	P10
EF-18	EF-18 Space Temperature (Room A105)	AI	N	Y	DEGREE C	P11
EF-1	EF-1 Enable	DO	N	N	ON/OFF	P12
EF-2	EF-2 Enable	DO	N	N	ON/OFF	P13
EF-10	EF-10 Enable / UH-6 Enable	DO	N	N	ON/OFF	P14
EF-18	EF-18 Enable	DO	N	N	ON/OFF	P15
UH-1	UH-1 Enable	DO	N	N	ON/OFF	P16

.12 Existing LCM-11 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
RH-5	Room C172 Space Temperature	AI	N	Y	DEGREE C	P01

RH-5	Room C172 Temperature Setpoint	AO	N	N	DEGREE C	P02
RH-6	Room C120 Space Temperature	AI	N	Y	DEGREE C	P03
RAD-3	Room C174 Space Temperature	AI	N	Y	DEGREE C	P04
RAD-3	Room C174 Temperature Setpoint	AO	N	N	DEGREE C	P05
RAD-4	Room C102 Space Temperature	AI	N	Y	DEGREE C	P06
RAD-4	Room C102 Temperature Setpoint	AO	N	Y	DEGREE C	P07
RH-5	Reheat Heating Valve Command	AO	N	Y	DEGREE C	P08
RAD-2	Radiation Valve Command	AO	N	Y	DEGREE C	P09
RH-6	Room C120 Radiation Valve Command	AO	N	Y	DEGREE C	P10
RAD-3	Room C174 Radiation Valve Command	AO	N	Y	DEGREE C	P11
RAD-4	Room C102 Radiation Valve Command	AO	N	Y	DEGREE C	P12
EF-3	EF-3 Status	DI	N	Y	ON/OFF	P13
	Not Used					P14
	Not Used					P15
EF-3	EF-3 Enable	DO	N	N	ON/OFF	P16

.13 Existing LCM-12 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
RAD Floor Z5	Z5 - Room 106 Temperature	AI	N	Y	DEGREE C	P01
RAD Floor Z5	Z5 - Room 106 Heating Valve Command	DO	N	Y	ON/OFF	P02
RAD Floor Z4	Z4 - Room 108 Temperature	AI	N	Y	DEGREE C	P03
RAD Floor Z4	Z4 - Room 108 Heating Valve Command	DO	N	Y	ON/OFF	P04
RAD Floor Z3	Z3 - Room 109 Temperature	AI	N	Y	DEGREE C	P05
RAD Floor	Z3 - Room 109	DO	N	Y	ON/OFF	P06

Z3	Heating Valve Command					
RAD Floor Z2	Z2 - Room 110 Temperature	AI	N	Y	DEGREE C	P07
RAD Floor Z2	Z2 - Room 110 Heating Valve Command	DO	N	Y	ON/OFF	P08
RAD Floor Z1	Z1 - Room 111 Temperature	AI	N	Y	DEGREE C	P09
RAD Floor Z1	Z1 - Room 111 Heating Valve Command	DO	N	Y	ON/OFF	P10
RAD Floor Z10	Z10 - Room 136 Temperature	AI	N	Y	DEGREE C	P11
RAD Floor Z10	Z10 - Room 136 Heating Valve Command	DO	N	Y	ON/OFF	P12
RAD Floor Z9	Z9 - Room 138 Temperature	AI	N	Y	DEGREE C	P13
RAD Floor Z9	Z9 - Room 138 Heating Valve Command	DO	N	Y	ON/OFF	P14
RAD Floor Z8	Z8 - Room 139 Temperature	AI	N	Y	DEGREE C	P15
RAD Floor Z8	Z8 - Room 139 Heating Valve Command	DO	N	Y	ON/OFF	P16

.14 Existing LCM-13 I/O Point Summary

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
RAD Floor Z7	Z7 - Room 140 Temperature	AI	N	Y	DEGREE C	P01
RAD Floor Z7	Z7 - Room 140 Heating Valve Command	DO	N	Y	ON/OFF	P02
RAD Floor Z6	Z6 - Room 141 Temperature	AI	N	Y	DEGREE C	P03
RAD Floor Z6	Z6 - Room 141 Heating Valve Command	DO	N	Y	ON/OFF	P04
RAD Floor Z19	Z19 - Room 128 Temperature	AI	N	Y	DEGREE C	P05
RAD Floor Z19	Z19 - Room 128 Heating Valve Command	DO	N	Y	ON/OFF	P06
RAD Floor	Z20 and 21 - Room	AI	N	Y	DEGREE C	P07

Z20 and Z21	132 Temperature					
RAD Floor Z20 and Z21	Z20 and 21 - Room 132 Heating Valve Command	DO	N	Y	ON/OFF	P08
RAD Floor Z13	Z13 - Room 100 Temperature	AI	N	Y	DEGREE C	P09
RAD Floor Z13	Z13 - Room 100 Heating Valve Command	DO	N	Y	ON/OFF	P10
RAD Floor Z11 and Z12	Z11 and 12 - Room 102 Temperature	AI	N	Y	DEGREE C	P11
RAD Floor Z11 and Z12	Z11 and 12 - Room 102 Heating Valve Command	DO	N	Y	ON/OFF	P12
RAD Floor Z14 and Z15	Z14 and 15 - Room 123 Temperature	AI	N	Y	DEGREE C	P13
RAD Floor Z14 and Z15	Z14 and 15 - Room 123 Temperature Setpoint	AO	N	N	DEGREE C	P14
RAD Floor Z14 and Z15	Z14 and 15 - Room 123 Heating Valve Command	DO	N	Y	ON/OFF	P15
	Not Used					P16

.15 Existing LCM-14 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
RAD Floor Z16	Z16 - Room 125 Temperature	AI	N	Y	DEGREE C	P01
RAD Floor Z16	Z16 - Room 125 Temperature Setpoint	AI	N	N	DEGREE C	P02
RAD Floor Z16	Z16 - Room 125 Heating Valve Command	DO	N	Y	ON/OFF	P03
RAD Floor Z17 and Z18	Z17 and 18 - Room 127 Temperature	AI	N	Y	DEGREE C	P04
RAD Floor Z17 and Z18	Z17 and 18 - Room 127 Temperature Setpoint	AI	N	N	DEGREE C	P05
RAD Floor Z17 and Z18	Z17 and 18 - Room 127 Heating Valve Command	DO	N	Y	ON/OFF	P06

B-501	Primary Hot Water Supply Temperature (TS1)	AI	N	Y	DEGREE C	P07
B-501	Primary Hot Water Return Temperature (TS2)	AI	N	Y	DEGREE C	P08
B-501A	Boiler B-501A Enable/Disable	DO	N	N	ON/OFF	P09
B-501B	Boiler B-501B Enable/Disable	DO	N	N	ON/OFF	P10
P-301	Pump P-301 Enable/Disable	DO	N	Y	ON/OFF	P11
P-301	Hot Water Supply Flow Switch	DI	N	Y	ON/OFF	P12
FCU-401	FCU-401 Enable Disable	DO	N	Y	ON/OFF	P13
FCU-401	FCU-401 Cooling Enable	DO	N	N	ON/OFF	P14
FCU-401	FCU-401 Status	DI	N	Y	ON/OFF	P15
	Not Used					P16

.16 Existing LCM-15 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	HWS Temperature to UH, HC-1, and DHW	AI	N	Y	DEGREE C	P01
	3-Way Valve for UH, HC-1 and DHW	AO	N	N	0-100%	P02
	Not Used					P03
	Not Used					P04
DHW	DHW Supply Temperature	AI	N	Y	DEGREE C	P05
DHW	3-Way Valve for Domestic Hot Water Supply	AO	N	N	0-100%	P06
	HWS to Radiant Floor Heating	AI	N	Y	DEGREE C	P07
	3-Way Valve for Radiant Floor Heating	AO	N	N	0-100%	P08
CP-303	Pump CP-303 Enable/Disable	DO	N	Y	ON/OFF	P09
CP-303	Pump CP-303 Status	DI	N	Y	ON/OFF	P10
HRV-1	HRV-1 Supply Air Temperature	AI	N	Y	DEGREE C	P11
HRV-1	3-Way Valve for HRV-1	AO	N	N	0-100%	P12

HRV-1	HRV-1 Heating Coil Return Temperature	AI	N	Y	DEGREE C	P13
	Not Used					P14
	Not Used					P15
	Not Used					P16

.17 Existing LCM-16 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-2A	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P01
AC-2A	Supply Fan Status	DI	N	Y	ON/OFF	P02
AC-2A	Room C201 Room Temperature	AI	N	Y	DEGREE C	P03
AC-2B	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P04
AC-2B	Supply Fan Status	DI	N	Y	ON/OFF	P05
AC-2B	Room C202 Room Temperature	AI	N	Y	DEGREE C	P06
AC-2C	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P07
AC-2C	Supply Fan Status	DI	N	Y	ON/OFF	P08
AC-2C	C203 Room Temperature	AI	N	Y	DEGREE C	P09
CU-2	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P10
AC-5	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P11
AC-5	Supply Fan Status	DI	N	Y	ON/OFF	P12
AC-5	Room C134 Room Temperature	AI	N	Y	DEGREE C	P13
CU-5	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P14
						P15
						P16

.18 Existing LCM-17 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-3A	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P01
AC-3A	Supply Fan Status	DI	N	Y	ON/OFF	P02
AC-3A	Room C155 Room Temperature	AI	N	Y	DEGREE C	P03
AC-3B	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P04

AC-3B	Supply Fan Status	DI	N	Y	ON/OFF	P05
AC-3B	Room C160 Room Temperature	AI	N	Y	DEGREE C	P06
CU-3	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P07
AC-4A	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P08
AC-4A	Supply Fan Status	DI	N	Y	ON/OFF	P09
AC-4A	Room C147 Room Temperature	AI	N	Y	DEGREE C	P10
AC-4B	Supply Fan Enable/Disable	DO	N	N	ON/OFF	P11
AC-4B	Supply Fan Status	DI	N	Y	ON/OFF	P12
AC-4B	Room B122 Room Temperature	AI	N	Y	DEGREE C	P13
CU-4	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P14
						P15
						P16

.19 Existing LCM-18 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-1	AC-1 Supply Air Temperature	AI	N	Y	DEGREE C	P01
AC-1	AC-1 Start/Stop	DO	N	N	ON/OFF	P02
AC-1	AC-1 Status	DI	N	Y	ON/OFF	P03
RH-6	Heating Coil Valve Command	AO	N	N	0-100%	P04
AC-1	Room C122 Temperature	AI	N	Y	DEGREE C	P05
AC-1	Room C115 Temperature	AI	N	Y	DEGREE C	P06
AC-1	AC-1 Heating Coil Control Valve Command	AO	N	Y	0-100%	P07
AC-1	CU-1 Condensing Unit Enable/Disable	DO	N	Y	ON/OFF	P08
AC-1	AC-1 Fresh Air Damper	DO	N	Y	OPEN/CLOSED	P09
						P10
						P11
						P12
						P13
						P14

						P15
						P16

.5 Two controllers have been added to accommodate the isolation room renovation within the healthcare unit.

.1 Existing MNL-001 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-1	AC-1 Status	DI	N	Y	ON/OFF	P01
EF-21	EF-21 Status	DI	N	Y	ON/OFF	P02
AC-1	Room C108 Pressure Differential	AI	N	Y	PASCALS	P03
AC-1	Room C107 Pressure Differential	AI	N	Y	PASCALS	P04
AC-1	SAD-1 Position	AI	N	Y	0-100%	P05
AC-1	EAD-1 Position	AI	N	Y	0-100%	P06
AC-1	Occupancy Switch	DI	N	Y	ON/OFF	P07
AC-1	Smoke Detector 5	DI	Y	N	ALARM/NORMAL	P08
AC-1	SAD-1 Actuator Command	AO	N	N	0-100%	P01
AC-1	EAD-1 Command	AO	N	N	0-100%	P02
AC-1	AC-1 Outside Air Damper Command	AO	N	N	0-100%	P03
	Not Used					P04
AC-1	AC-1 Enable	DO	N	N	ON/OFF	P01
EF-21	EF-21 Enable	DO	N	N	ON/OFF	P02
AC-1	Room C108 Differential Pressure Status	DO	Y	N	ALARM/NORMAL	P03
AC-1	Room C107 Differential Pressure Status	DO	Y	N	ALARM/NORMAL	P04
AC-1	AC-1 Status - Dry Contact	DO	N	N	ON/OFF	P05
AC-1	Occupied Mode - Dry Contact	DO	N	N	ON/OFF	P06
AC-1	Occupied Mode Light	DO	N	N	ON/OFF	P07
	Not Used					P08

.2 Existing MNL-001 I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-1	Room C108 Space Temperature	AI	N	Y	DEGREE C	P01
AC-1	Room C108	AI	N	Y	DEGREE C	P02

	Temperature Setpoint					
AC-1	Room C108 Humidity	AI	N	Y	% RH	P03
AC-1	AC-1 Status	DI	N	Y	ON/OFF	P04
AC-1	Occupied Mode	DI	N	Y	ON/OFF	P05
	Not Used					P06
	Not Used					P07
	Not Used					P08
HUM-1	Humidifier Output Command	AO	N	N	0-100%	P01
RH-8	RH-8 Heating Actuator Control	AO	N	N	0-100%	P02
	Not Used					P03
	Not Used					P04
AC-1	Room C107 Temperature Alarm	DO	Y	N	ALARM/NORMAL	P01
AC-1	Room C107 Humidity Alarm	DO	Y	N	ALARM/NORMAL	P02
RH-8	RH-8 Heating Enable	DO	N	N	ON/OFF	P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
HUM-1	Humidifier Enable	DO	N	N	ON/OFF	P07
	Not Used					P08

.6 Microzone controllers have been installed and continued their numbering from the twelve existing VAV controllers. The Microzone controllers exist from 13-25. Microzone 24 does not exist.

.1 The Microzone#13 controller is believed to have been demolished along with two associated split cooling units.

.2 Existing Microzone#14 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	Room 105 Space Temperature	AI	N	Y	DEGREE C	P01
CH-3	Staff Washroom Temperature	AI	N	Y	DEGREE C	P02
AC-2	Office 123 Space Temperature	AI	N	Y	DEGREE C	P03
EF-1	EF-1 Status	DI	N	Y	ON/OFF	P04
EF-6	EF-6 Status	DI	N	Y	ON/OFF	P05
HC-5	Room 120 Space Temperature	AI	N	Y	DEGREE C	P06
	Not Used					P07

	Not Used					P08
	Not Used					P01
CH-3	CH-3 Heating Valve Command	AO	N	Y	0-100%	P02
HC-5	HC-5 Heating Valve Command	AO	N	Y	0-100%	P03
	Not Used					P04
	EF-1 Start/Stop	DO	N	N	ON/OFF	P01
	EF-6 Start/Stop	DO	N	N	ON/OFF	P02
	MD-3 Open/Close	DO	N	N	ON/OFF	P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.3 Existing Microzone#15 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	Not Used					P01
HC-4	Room 125 Space Temperature	AI	N	Y	DEGREE C	P02
RAD Floor Z1	Room 164 Space Temperature	AI	N	Y	DEGREE C	P03
RAD Floor Z2	Room 168 Space Temperature	AI	N	Y	DEGREE C	P04
AC-1	Room 130 Space Temperature	AI	N	Y	DEGREE C	P05
CH-2	Stair #2 Space Temperature	AI	N	Y	DEGREE C	P06
CH-1	Stair #3 Space Temperature	AI	N	Y	DEGREE C	P07
	Not Used					P08
	Not Used					P01
HC-4	HC-4 Heating Valve Command	AO	N	Y	0-100%	P02
CH-2	CH-2 Heating Valve Command	AO	N	Y	0-100%	P03
CH-1	CH-1 Heating Valve Command	AO	N	Y	0-100%	P04
RAD Floor Z1	Z1 - Room 164 Heating Valve Command	DO	N	N	OPEN/CLOSE	P01
RAD Floor Z2	Z2 - Room 168 Heating Valve	DO	N	N	OPEN/CLOSE	P02

	Command					
	Not Used					P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.4 Existing Microzone#16 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
HC-3	Room 201 Space Temperature	AI	N	Y	DEGREE C	P01
RAD Floor Z5	Room 214 Space Temperature	AI	N	Y	DEGREE C	P02
RAD Floor Z6	Room 217 Space Temperature	AI	N	Y	DEGREE C	P03
RAD Floor Z3	Room 234 Space Temperature	AI	N	Y	DEGREE C	P04
RAD Floor Z4	Room 237 Space Temperature	AI	N	Y	DEGREE C	P05
	Not Used					P06
	Not Used					P07
	Not Used					P08
HC-3	HC-3 Heating Valve Command	AO	N	Y	0-100%	P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
RAD Floor Z5	Z5 - Room 214 Heating Valve Command	DO	N	N	OPEN/CLOSE	P01
RAD Floor Z6	Z6 - Room 217 Heating Valve Command	DO	N	N	OPEN/CLOSE	P02
RAD Floor Z3	Z3 - Room 234 Heating Valve Command	DO	N	N	OPEN/CLOSE	P03
RAD Floor Z4	Z4 - Room 237 Heating Valve Command	DO	N	N	OPEN/CLOSE	P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.5 Existing Microzone#17 controller I/O Point Summary

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
B-1	Boiler B-1 Status	DI	N	Y	ON/OFF	P01
B-2	Boiler B-2 Status	DI	N	Y	ON/OFF	P02
P-1	Pump P-1 Status	DI	N	Y	ON/OFF	P03
P-2	Pump P-2 Status	DI	N	Y	ON/OFF	P04
	Hot Water Supply Temperature	AI	N	Y	DEGREE C	P05
AC-3	AC-3 Supply Fan Status	DI	N	Y	ON/OFF	P06
AC-3	Room 303 Temperature	AI	N	Y	DEGREE C	P07
	Not Used					P08
	Not Used					P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
B-1	Boiler B-1 Enable	DO	N	N	ON/OFF	P01
B-2	Boiler B-2 Enable	DO	N	N	ON/OFF	P02
P-1	Pump P-1 Start/Stop	DO	N	N	ON/OFF	P03
P-2	Pump P-2 Start/Stop	DO	N	N	ON/OFF	P04
AC-3	AC-3 Supply Fan Start/Stop	DO	N	N	ON/OFF	P05
AC-3	Condensing Unit CU-3 Enable	DO	N	N	ON/OFF	P06
	Not Used					P07
	Not Used					P08

.6 Existing Microzone#18 controller I/O Point Summary

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
P-3	Pump P-3 Status	DI	N	Y	ON/OFF	P01
P-4	Pump P-4 Status	DI	N	Y	ON/OFF	P02
P-9	Pump P-9 Status	DI	N	Y	ON/OFF	P03
P-10	Pump P-10 Status	DI	N	Y	ON/OFF	P04
DHW	DHW Hot Water Supply Temperature	AI	N	Y	DEGREE C	P05
DHW	DHW HWS High Temperature Alarm	DI	N	N	ON/OFF	P06
	Not Used					P07
	Not Used					P08
DHW	DHW 3-Way Valve Command	AO	N	N	0-100%	P01

	Not Used					P02
	Not Used					P03
	Not Used					P04
P-3	Pump P-3 Start/Stop	DO	N	N	ON/OFF	P01
P-4	Pump P-4 Start/Stop	DO	N	N	ON/OFF	P02
P-9	Pump P-9 Start/Stop	DO	N	N	ON/OFF	P03
P-10	Pump P-10 Start/Stop	DO	N	N	ON/OFF	P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.7 Existing Microzone#19 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
P-5	Pump P-5 Status	DI	N	Y	ON/OFF	P01
P-6	Pump P-6 Status	DI	N	Y	ON/OFF	P02
P-7	Pump P-7 Status	DI	N	Y	ON/OFF	P03
P-8	Pump P-8 Status	DI	N	Y	ON/OFF	P04
	Scheduled Hot Water Supply Temperature	AI	N	Y	DEGREE C	P05
	Radiant Floor Hot Water Supply Temperature	AI	N	Y	DEGREE C	P06
	Radiant Floor HWS High Temperature Alarm	DI	N	N	ON/OFF	P07
	Not Used					P08
	Scheduled HWS Valve Command					P01
	Radiant Floor HWS Valve Command					P02
	Not Used					P03
	Not Used					P04
P-5	Pump P-5 Start/Stop	DO	N	N	ON/OFF	P01
P-6	Pump P-6 Start/Stop	DO	N	N	ON/OFF	P02
P-7	Pump P-7 Start/Stop	DO	N	N	ON/OFF	P03
P-8	Pump P-8 Start/Stop	DO	N	N	ON/OFF	P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.8 Existing Mircozone#20 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-1	AC-1 Supply Air Temperature	AI	N	Y	DEGREE C	P01
AC-1	AC-1 Supply Fan Status	DI	N	Y	ON/OFF	P02
AC-2	AC-2 Supply Air Temperature	AI	N	Y	DEGREE C	P03
AC-2	AC-2 Supply Fan Status	DI	N	Y	ON/OFF	P04
AHU-1	AHU-1 Supply Fan Status	DI	N	Y	ON/OFF	P05
AHU-1	AHU-1 Return Fan Status	DI	N	Y	ON/OFF	P06
AHU-1	AHU-1 Supply Air Temperature	AI	N	Y	DEGREE C	P07
AHU-1	AHU-1 Return Air Temperature	AI	N	Y	DEGREE C	P08
HC-1	HC-1 Heating Valve Command	AO	N	N	0-100%	P01
HC-2	HC-2 Heating Valve Command	AO	N	N	0-100%	P02
AHU-1	AHU-1 Heating Valve Command	AO	N	N	0-100%	P03
						P04
AC-1	AC-1 Supply Fan Start/Stop	DO	N	N	ON/OFF	P01
CU-1	CU-1 Enable	DO	N	N	ON/OFF	P02
AC-1	AC-1 Economizer Enable	DO	N	Y	ON/OFF	P03
AC-2	AC-2 Supply Fan Start/Stop	DO	N	N	ON/OFF	P04
CU-2	CU-2 Enable	DO	N	N	ON/OFF	P05
AC-2	AC-2 Economizer Enable	DO	N	Y	ON/OFF	P06
AHU-1	AHU-1 Supply Fan Start/Stop	DO	N	N	ON/OFF	P07
AHU-1	AHU-1 Return Fan Start/Stop	DO	N	N	ON/OFF	P08

.9 Existing Microzone#21 controller Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-6	AC-6 Supply Air Temperature	AI	N	Y	DEGREE C	P01

AC-6	AC-6 Supply Fan Status	DI	N	Y	ON/OFF	P02
AC-6	Room 107 Space Temperature	AI	N	Y	DEGREE C	P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08
HC-6	Heating Valve Command	AO	N	N	0-100%	P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
AC-6	AC-6 Supply Fan Start/Stop	DO	N	N	ON/OFF	P01
CU-6	CU-6 Enable	DO	N	N	ON/OFF	P02
AC-6	AC-6 Fresh Air Damper Command	DO	N	N	OPEN/CLOSE	P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.10 Existing Microzone#22 controller I/O Point Summary.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-6	Evaporator Status	DI	N	Y	ON/OFF	P01
AC-7	Evaporator Status	DI	N	Y	ON/OFF	P02
AC-6 / AC-7	Room C206 Room Temperature	AI	N	Y	DEGREE C	P03
AC-8	Evaporator Status	DI	N	Y	ON/OFF	P04
AC-8	Room C207 Room Temperature	AI	N	Y	DEGREE C	P05
AC-9	Evaporator Status	DI	N	Y	ON/OFF	P06
AC-9	Room C208 Room Temperature	AI	N	Y	DEGREE C	P07
	Not Used					P08
	Supply Air Damper	AO	N	Y	0-100%	P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
AC-6	Evaporator	DO	N	N	ON/OFF	P01

	Enable/Disable					
AC-7	Evaporator Enable/Disable	DO	N	N	ON/OFF	P02
AC-8	Evaporator Enable/Disable	DO	N	N	ON/OFF	P03
AC-9	Evaporator Enable/Disable	DO	N	N	ON/OFF	P04
CU-6	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.11 Existing Microzone#23 controller I/O Point summary

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
AC-10	Evaporator Status	DI	N	Y	ON/OFF	P01
AC-10	Room C209 Room Temperature	AI	N	Y	DEGREE C	P02
AC-11	Evaporator Status	DI	N	Y	ON/OFF	P03
AC-12	Evaporator Status	DI	N	Y	ON/OFF	P04
	Not Used					P05
AC-13	Evaporator Status	DI	N	Y	ON/OFF	P06
AC-13	Room C133 Room Temperature	AI	N	Y	DEGREE C	P07
	Not Used					P08
	Not Used					P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
AC-10	Evaporator Enable/Disable	DO	N	N	ON/OFF	P01
AC-11	Evaporator Enable/Disable	DO	N	N	ON/OFF	P02
AC-12	Evaporator Enable/Disable	DO	N	N	ON/OFF	P03
AC-13	Evaporator Enable/Disable	DO	N	N	ON/OFF	P04
CU-7	Condenser Unit Enable/Disable	DO	N	N	ON/OFF	P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.12 Existing Microzone controller 25 I/O Point summary. Microzone controller 25 is located within South Storage building.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units	Terminal
	Heated Storage Area Temperature	AI	N	Y	DEGREE C	P01
	Fork Lift Area Temperature	AI	N	Y	DEGREE C	P02
	Not Used					P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08
	Not Used					P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
	Not Used					P01
	Not Used					P02
	Not Used					P03
	Not Used					P04
	Not Used					P05
	Not Used					P06
	Not Used					P07
	Not Used					P08

.7 A new micro controller has been added to accommodate an addition to the SLE radiant floor system. Below is the existing SLE microcontroller I/O Point Summary. Contractor to verify terminal connections prior to BAS programming.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
RAD Floor Z22	Z22 - Room 150 Space Temperature	AI	N	Y	DEGREE C
RAD Floor Z22	Z22 - Room 150 Slab Temperature	AI	Y	Y	DEGREE C
RAD Floor Z22	Z22 - Room 150 Heating Valve Command	AO	N	N	OPEN/CLOSE
RAD Floor Z23	Z23 - Room 149 Space Temperature	AI	N	Y	DEGREE C
RAD Floor Z23	Z23 - Room 149 Slab Temperature	AI	Y	Y	DEGREE C
RAD Floor	Z23 - Room 149	AO	N	N	OPEN/CLOSE

Z23	Heating Valve Command				
	Z23 - Manifold E two-way Valve	AO	N	N	OPEN/CLOSE
	Z23 - Manifold E Pump Enable/Disable	DO	N	N	ON/OFF
RAD Floor Z24	Z24 - Room 148 Space Temperature	AI	N	Y	DEGREE C
RAD Floor Z24	Z24 - Room 148 Slab Temperature	AI	Y	Y	DEGREE C
RAD Floor Z24	Z24 - Room 148 Heating Valve Command	AO	N	N	OPEN/CLOSE
RAD Floor Z25	Z25 - Room 147 Space Temperature	AI	N	Y	DEGREE C
RAD Floor Z25	Z25 - Room 147 Slab Temperature	AI	Y	Y	DEGREE C
RAD Floor Z25	Z25 - Room 147 Heating Valve Command	AO	N	N	OPEN/CLOSE
	Z25 - Manifold E Two-way Valve	AO	N	N	OPEN/CLOSE
	Z25 - Manifold E Pump Enable/Disable	DO	N	N	ON/OFF

- .8 A new microcontroller and Mitsubishi Gateway were installed for the MCCP renovation. Below is the I/O Point Summary for the space. Contractor to verify point connection terminals prior to reprogramming the BAS.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
MCCP-AC-1	AC-1 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-1	AC-1 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-1	AC-1 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM
MCCP-AC-1	AC-1 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-CU-1	MCCP-CU-1 Condenser Enable	DO	N	Y	ON/OFF
MCCP-AC-2	AC-2 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-2	AC-2 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-2	AC-2 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM

MCCP-AC-2	AC-2 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-AC-3	AC-3 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-3	AC-3 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-3	AC-3 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM
MCCP-AC-3	AC-3 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-AC-4	AC-4 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-4	AC-4 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-4	AC-4 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM
MCCP-AC-4	AC-4 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-AC-5	AC-5 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-5	AC-5 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-5	AC-5 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM
MCCP-AC-5	AC-5 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-AC-6	AC-6 Evaporator Enable/Disable	DO	N	Y	ON/OFF
MCCP-AC-6	AC-6 Evaporator Status	DI	N	Y	ON/OFF
MCCP-AC-6	AC-6 Evaporator Alarm	DI	Y	N	ALARM/NO ALARM
MCCP-AC-6	AC-6 Evaporator Room Temperature	AI	N	Y	DEGREE C
MCCP-CU-6	MCCP-CU-2 Enable/Disable	DO	N	Y	ON/OFF
BB-1	Washroom 104B Room Temperature	AI	N	Y	DEGREE C
BB-1	Washroom 104B Temperature Setpoint	AO	N	Y	DEGREE C
BB-1	Washroom 104B Baseboard Enable/Disable	DO	N	N	ON/OFF
EF-4N	Exhaust Fan 4N Enable/Disable	DO	N	N	ON/OFF

EF-4N	Exhaust Fan 4N Status	DI	N	Y	ON/OFF
SF-1N	Outside Air Damper Enable/Disable	DO	N	Y	OPEN/CLOSE
SF-1N	Supply Fan Enable	DO	N	Y	ON/OFF
SF-1N	Supply Fan Low Speed	DO	N	Y	ON/OFF
SF-1N	Supply Fan High Speed	DO	N	Y	ON/OFF
SF-1N	Supply Fan Status	DI	N	Y	ON/OFF
SF-1N	Supply Fan Emergency Mode Enable/Disable	DO	Y	N	ON/OFF
SF-1N	Supply Fan Emergency Mode Time Delay	DELAY	N	N	MINUTES
SF-1N	Supply Fan Supply Temperature	AI	N	Y	DEGREE C
DH-1	Duct Heater Capacity Controls	AO	N	Y	0-100%
HUM-1	Humidifier Enable/Disable Override	DO	N	N	ON/OFF
HUM-1	Humidifier Enable/Disable Logic	AO	N	N	DEGREE C
HUM-1	Humidifier Status	DI	N	Y	ON/OFF
HUM-1	Humidifier High Limit Set Point	AO	N	N	% RH

1.5

GVI FACILITY ADDITIONAL I/O POINT SUMMARY

- .1 The Contractor is to integrate the following points into the new BAS as part of the replacement. New conduit, wiring, controllers, and devices are to be installed as necessary.
- .2 Contractor to add the following points for the GVI Main Building as part of the BAS replacement.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
EF-1	EF-1 Enable	DO	N	N	ON/OFF
EF-2	EF-2 Status	DI	N	Y	ON/OFF
EF-7	EF-7 Status	DI	N	Y	ON/OFF
UH-1	UH-1 Space Temperature	AI	N	Y	DEGREE C
UH-1A	UH-1A Status	DI	N	Y	ON/OFF
UH-1A	UH-1A Enable	DO	N	N	ON/OFF
UH-1A	UH-1A Space	AI	N	Y	DEGREE C

	Temperature				
UH-2	UH-2 Space Temperature	AI	N	Y	DEGREE C
	Room A117 Temperature Setpoint	AO	N	Y	DEGREE C
UH-4	UH-4 Enable	DO	N	N	ON/OFF
UH-4	UH-4 Space Temperature	AI	N	Y	DEGREE C
	Room A122 Temperature Setpoint	AO	N	Y	DEGREE C
UH-4	UH-4 Status	DI	N	Y	ON/OFF
UH-5	UH-5 Enable	DO	N	N	ON/OFF
	Room C162 Temperature Setpoint	AO	N	N	DEGREE C
UH-5	UH-5 Status	DI	N	Y	ON/OFF
UH-6	UH-6 Status	DI	N	Y	ON/OFF
UH-7	UH-7 Status	DI	N	Y	ON/OFF
UH-7	UH-7 Enable	DO	N	N	ON/OFF
UH-8	UH-8 Enable	DO	N	N	ON/OFF
UH-8	UH-8 Space Temperature	AI	N	Y	DEGREE C
UH-8	UH-8 Temperature Setpoint	AO	N	Y	DEGREE C
UH-13	UH-13 Status	DI	N	Y	ON/OFF
UH-14	UH-14 Status	DI	N	Y	ON/OFF
	Room C202 Temperature Setpoint	AO	N	N	DEGREE C
AC-14	AC-14 Enable	DO	N	N	ON/OFF
AC-14	AC-14 Status	DI	N	Y	ON/OFF
AC-14	Room B111 Space Temperature	AI	N	Y	DEGREE C
AC-14	Room B111 Temperature Setpoint	AI	N	Y	DEGREE C
AC-15	AC-15 Enable	DO	N	N	ON/OFF
AC-15	AC-15 Status	DI	N	Y	ON/OFF
AC-15	Room B150 Space Temperature	AI	N	Y	DEGREE C
AC-15	Room B150 Temperature	AI	N	Y	DEGREE C

	Setpoint				
AC-16 (AC-MED)	AC-15 Enable	DO	N	N	ON/OFF
AC-16 (AC-MED)	AC-15 Status	DI	N	Y	ON/OFF
AC-16 (AC-MED)	Room C126 Space Temperature	AI	N	Y	DEGREE C
AC-16 (AC-MED)	Room C126 Temperature Setpoint	AI	N	Y	DEGREE C
AC-17 (NONE)	AC-17 Enable	DO	N	N	ON/OFF
AC-17 (NONE)	AC-17 Status	DI	N	Y	ON/OFF
AC-17 (NONE)	Room C167 Space Temperature	AI	N	Y	DEGREE C
AC-17 (NONE)	Room C167 Temperature Setpoint	AI	N	Y	DEGREE C
CU-17 (NONE)	CU-17 Enable	DO	N	N	ON/OFF
AC-18 (NONE)	AC-18 Enable	DO	N	N	ON/OFF
AC-18 (NONE)	AC-18 Status	DI	N	Y	ON/OFF
AC-18 (NONE)	Room C146 Space Temperature	AI	N	Y	DEGREE C
AC-18 (NONE)	Room C146 Temperature Setpoint	AI	N	Y	DEGREE C
CU-18 (NONE)	CU-18 Enable	DO	N	N	ON/OFF
AC-19 (NONE)	AC-19 Enable	DO	N	N	ON/OFF
AC-19 (NONE)	AC-19 Status	DI	N	Y	ON/OFF
AC-19 (NONE)	Room C148 Space Temperature	AI	N	Y	DEGREE C
AC-19 (NONE)	Room C148 Temperature Setpoint	AI	N	Y	DEGREE C
CU-19 (NONE)	CU-19 Enable	DO	N	N	ON/OFF
FCU-PW133 (NONE)	FCU-PW133 Enable	DO	N	N	ON/OFF
FCU-PW133	FCU-PW133 Status	DI	N	Y	ON/OFF

(NONE)					
FCU-PW133 (NONE)	Room PW133 Space Temperature	AI	N	Y	DEGREE C
FCU-PW133 (NONE)	Room PW133 Temperature Setpoint	AI	N	Y	DEGREE C
FCU-PW133 (NONE)	FCU-PW133 S/A Temperature	AI	N	Y	DEGREE C
FCU-PW133 (NONE)	O/A Damper Command	AO	N	N	0-100%
FCU-PW133 (NONE)	E/A Damper Command	AO	N	N	0-100%
CU-PW133 (NONE)	CU-PW133 Enable	DO	N	N	ON/OFF

.3 Contractor to add the following points to the SLE as part of the BAS replacement.

- .1 The existing roof top unit contains a BACnet integration card. Contractor to map available points to BAS. The following points provided in the table for RTU-1 must be mapped at a minimum.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
RTU-1	Supply Air Temperature	BACnet	N	Y	DEGREE C
RTU-1	Enable	BACnet	N	N	ON/OFF
RTU-1	Status	BACnet	N	Y	ON/OFF
RTU-1	Room 116 Space Temperature	BACnet	N	Y	DEGREE C
RTU-1	Alarm	BACnet	Y	N	ALARM/NORMAL
AC-1	Status	DI	N	Y	ON/OFF
AC-1	Room 118 Space Temperature	AI	N	Y	DEGREE C
AC-1	Enable	DO	N	N	ON/OFF
AC-1	Room 118 Temperature Setpoint	AI	N	N	DEGREE C
UH-401	Status	DI	N	Y	ON/OFF
UH-401	Enable	DO	N	N	ON/OFF
UH-401	Space Temperature	AI	N	Y	DEGREE C
CP-302	Enable	DO	N	N	ON/OFF
CP-302	Status	DI	N	Y	ON/OFF
CP-304	Enable	DO	N	N	ON/OFF
CP-304	Status	DI	N	Y	ON/OFF

- .4 Contractor to add the following points to the Intensive Intervention Unit (IIU) as part of the BAS replacement.

Equipment Tag	Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
AC-1	AC-1 Smoke Detector	DI	Y	N	ALARM/NORMAL
AC-2	AC-2 Smoke Detector	DI	Y	N	ALARM/NORMAL
AHU-1	AHU-1 Smoke Detector	DI	Y	N	ALARM/NORMAL
UH-1	Enable	DO	N	N	ON/OFF
UH-1	Status	DI	N	Y	ON/OFF
UH-1	Space Temperature	AI	N	Y	DEGREE C
UH-2	Enable	DO	N	N	ON/OFF
UH-2	Status	DI	N	Y	ON/OFF
UH-2	Space Temperature	AI	N	Y	DEGREE C
UH-3	Enable	DO	N	N	ON/OFF
UH-3	Status	DI	N	Y	ON/OFF
UH-3	Space Temperature	AI	N	Y	DEGREE C
EF-1	Enable	DO	N	N	ON/OFF
EF-1	Status	DI	N	Y	ON/OFF
EF-5	Enable	DO	N	N	ON/OFF
EF-5	Status	DI	N	Y	ON/OFF
P-11	Enable	DO	N	N	ON/OFF
P-11	Status	DI	N	Y	ON/OFF

1.6 PEB I/O POINT SUMMARY

- .1 Provide the I/O points indicated below for each system at a minimum.
- .2 Contractor to allow for provide additional points necessary to achieve sequence of operation for each system described in section 1.8.
- .3 It is the Contractor's responsibility to verify which points are available through the BACnet interface of the individual equipment listed in the I/O Point Summary Table. Points listed below that are not provided through the BACnet interface shall be provided by the Controls Contractor including all necessary field control devices and installation labour. Refer to individual equipment specification sections for minimum manufacturer supplied points for the BAS.
- .4 Contractor is responsible to map all points available from mechanical equipment manufacturer supplied gateway to BAS for complete control of equipment from BAS.
- .5 Contractor to allow for mapping all available BAS points from individual equipment. Refer to approved shop drawings for complete list of BAS accessible points. Points provided below are the minimum that must be available from the manufacturer.

Point Name (To be filled in by Controls Contractor)	Description	Type
Constant Volume Bypass Box		
	Terminal Unit Space Temperature	AI
	Terminal Unit Damper Control	AO
	Space Temperature Setpoint	
	Terminal Unit Supply Air Temperature	AI
	Terminal Unit Heating Valve Control	AO
Variable Volume Diffusers		
	Space Temperature	AI
	Space Temperature Setpoint	AO
Inline Exhaust Fans		
	Fan Status	DI
	Fan Enable	DO
	Damper Open/Close	DO
	Damper Position Feedback	AI
Sump Pump		
	Sump Pump P-3 Status	DI
	Sump Pump High Level Alarm	DI
	Sump Pump Oil Alarm	DI
	High motor amps or locked rotor	AI
Condenser Loop		
	Condenser Loop Pump P-1 Variable Speed Drive – Status	BACnet
	Condenser Loop Pump P-2 Variable Speed Drive - Status	BACnet
	Condenser Loop Pump P-1 – Status	DI
	Condenser Loop Pump P-2 - Status	DI
	Condenser Loop Pump P-1 Variable Speed Drive – General Alarm	BACnet
	Condenser Loop Pump P-2 Variable Speed Drive – General Alarm	BACnet
	Condenser Loop Pump P-1 Variable Speed Drive – Enable/Disable	BACnet
	Condenser Loop Pump P-2 Variable Speed Drive – Enable/Disable	BACnet
	Condenser Loop Pump P-1 – Enable/Disable	DO
	Condenser Loop Pump P-2 – Enable/Disable	DO
	Condenser Loop Pump P-1 Variable Speed Drive – Speed	BACnet
	Condenser Loop Pump P-2 Variable Speed Drive – Speed	BACnet
	Condenser Loop Pump P-1 – VFD Speed	AO
	Condenser Loop Pump P-2 – VFD Speed	AO
	Condenser Loop Differential Pressure	AI

	Condenser Loop Supply Temperature	AI
	Condenser Loop Return Temperature	AI
	Condenser Loop Heating Setpoint	AO
	Condenser Loop Cooling Setpoint	AO
	Dry Cooler Enable/Disable	DO
	Dry Cooler Status	DI
	Dry Cooler Supply Water Temperature	AI
	Dry Cooler Return Water Temperature	AI
	Dry Cooler Flow Switch	DI
	Dry Cooler Three-way Valve	AO
	Dry Cooler Three-way Valve Position	AI
	Boiler Status	BACnet
	Boiler Enable/Disable	BACnet
	Boiler Supply Temperature Setpoint	BACnet
	Boiler Alarm	BACnet
	Boiler Supply Water Temperature	AI
Humidifier		
	Change Cylinder	BACnet
	System Demand	BACnet
	Remote Fault Indication	BACnet
	Remote Status Indication	BACnet
	Humidifier Input	BACnet
	Relative Humidity Setpoint	BACnet
	Demand	BACnet
	Humidifier Enable/Disable	BACnet
	Airflow	DI
	Supply Air Humidity High Limit	DI
	Return Air Humidity	AI
Glycol Feed System		
	Glycol Tank Low Level	DI
Forced Air Heaters		
	Forced Air Heater Status	DI
	Forced Air Heater Enable/Disable	DO
	Forced Air Heater Space Temperature	AI
Dedicated Outside Air System		
	Outside Air Temperature	BACnet
	Supply Air Temperature	BACnet
	Return Air Temperature	BACnet
	Exhaust Air Temperature	BACnet
	Outside Air Humidity	BACnet
	Return Air Humidity	BACnet
	Supply Blower Operation	BACnet
	Cooling Setpoint	BACnet
	Cooling Temperature Band	BACnet
	Heating Setpoint	BACnet
	Heating Temperature Band	BACnet
	Damper Positions	BACnet
Air Cooled VRF System		

	Start/Stop	DO
	Status	DI
	Error	DI
	Heating/Cooling Changeover	DO

1.7

GVI FACILITY SEQUENCES OF OPERATION

- .1 Present sequencing of operations for system(s), in accordance with MD 250005 - 2009 Energy Monitoring and Control Systems (EMCS) Design Guidelines and as indicated in this section.
- .2 Sequences of operations for Systems within GVI Main Building are as follows (LCM-01 to LCM-11, GCM and LCM-16 to LCM-18):

- .1 Gymnasium Lighting:
 - .1 Gym lights shall be controlled on a time of day schedule. Obtain gym operational times from Departmental Representative for initial programming. Gym lighting to be provided with an override switch with user adjustable time delay.
- .2 Heating Water Loop:
 - .1 On a signal from the BAS, the boilers shall be enabled.
 - .2 On a signal from the BAS the pumps shall be enabled.
 - .3 The pumps are constant speed and operate in a duty/standby arrangement.
 - .4 The operator shall have the ability to select the lead pump. The pumps shall be automatically rotated on a weekly basis for even wear.
 - .5 The differential pressure setpoint shall be adjustable (initially programmed to be 172 kPa. The bypass valve, CV-9, shall modulate to maintain differential pressure setting.
 - .6 The Hot Water Supply temperature setpoint shall be reset based on outside air temperature. The temperature setpoints shall be as follows:
 - .1 OA Low = -23.3°C, HWS Low = 82.2°C
 - .2 OA High = 15.6°C, HWS High = 62.8°C
 - .7 Boilers shall stage on and off in sequence to maintain heating water supply temperature.
 - .8 When one pump fails an alarm shall be generated at the BAS. The second pump shall be automatically started.
- .3 AHU-1:
 - .1 AHU-1 shall be enabled from the BAS according to a 7-day schedule. Controls contractor is to obtain operation schedule from Departmental Representative.
 - .2 When AHU-1 is enabled, the supply fan shall start and modulate to the supply duct differential pressure setpoint as sensed by the sensor located in the downstream ductwork.
 - .3 The return fan shall start and modulate to track the supply air volume minus a volumetric offset. The offset shall be 943 l/s less than the supply air volume flow rate.
 - .4 The outside air damper shall open to the minimum setting.

- .5 The heating and cooling shall be modulated by the BAS and the AHU controller respectively to maintain the supply air temperature setpoint. The supply air temperature shall be dynamically reset to cool with the warmest temperature up to a maximum of 18.3°C. The BAS shall monitor the VAV box thermostats increase the temperature by 1°C every 10 minutes when all rooms are maintained within temperature setpoint. The supply air temperature shall be reset downwards by 1°C every 10 minutes when there are two or more rooms above the cooling temperature setpoint.
 - .6 The differential pressures setpoint shall be dynamically reset based on VAV box damper position. The differential pressure setpoint shall be reset upwards and downwards to maintain at least one VAV box with a damper position fully open.
 - .7 VAV boxes to modulate air flow damper to maintain space temperature below cooling setpoint. Cooling setpoint to shall be adjustable from the BAS and initially set at 24°C.
 - .8 VAV box reheat coils and space radiant heaters shall modulate to maintain space temperature above heating setpoint. Heating setpoint shall be adjustable from the BAS and initially set at 20°C.
 - .9 The humidity setpoint shall be reset based on outside air temperatures. The humidity setpoint shall be reset as follows:
 - .1 OA Low = 7°C; Humidity Low = 30%RH
 - .2 OA High = 15°C; Humidity High = 50% RH
 - .10 Humidifier output shall be calculated to maintain humidity setpoint at 22°C. Humidifier shall modulate and adjust output to provide sufficient humidity within supply air airstream to reach final setpoint within the conditioned space.
 - .11 Humidifier shall only operate on proof of supply fan operation. Humidifier shall have a high humidity shut-down of 80%RH sensed downstream of humidifier output wand.
 - .12 When the AHU-1 is scheduled to be off, the supply fan and return fan shall remain off, and the outside air damper shall be closed. If a space drops below the heating temperature setpoint and does not have a radiant heating equipment to supply heat to the space, the AHU-1 shall start in 100% recirculation mode to satisfy the heating setpoint. The minimum run time shall be 15minutes. If the cooling setpoint is not satisfied when the AHU-1 is scheduled to be off, the AHU-1 shall remain off.
 - .13 The BAS shall generate an alarm at the BAS in the event that the AHU-1 is scheduled to be on and the status is unavailable from either the supply or return fan.
 - .14 The BAS shall generate an alarm at the BAS in the event the supply air temperature is less than 10°C.
- .4 AHU-2:
- .1 AHU-2 shall be enabled from the BAS according to a 7-day schedule. Controls contractor is to obtain operation schedule from Departmental Representative.
-

- .2 When AHU-2 is enabled, the supply fan shall start and the outside air damper shall open to its minimum setting. The return fan shall start. Both fans to operate continuously.
 - .3 The supply air temperature setpoint shall be based on a space temperature reset schedule. The temperature setpoints shall be programmed as below:
 - .1 Space Temperature Low = 16°C; SA Setpoint Low = 28°C
 - .2 Space Temperature High = 22°C; SA Setpoint High = 22°C
 - .4 Downstream reheat coils shall modulate the heating valve to maintain individual space temperatures above the heating setpoint. The heating temperature setpoints shall be adjustable from the BAS, initially set to 20°C.
 - .5 When the AHU-2 is scheduled to be off, the supply fan and return fan shall remain off, and the outside air damper shall be closed. If a space drops below the heating temperature setpoint and does not have a radiant heating equipment to supply heat to the space, the AHU-2 shall start in 100% recirculation mode to satisfy the heating setpoint. The minimum run time shall be 15minutes.
 - .6 The BAS shall generate an alarm at the BAS in the event that the AHU-2 is scheduled to be on and the status is unavailable from either the supply or return fan.
 - .7 The BAS shall generate an alarm at the BAS in the event the supply air temperature is less than 10°C.
- .5 AHU-3:
- .1 The supply air temperature setpoint shall be based on a space temperature reset schedule. The temperature setpoints shall be programmed as below:
 - .1 Space Temperature Low = 16°C; SA Setpoint Low = 28°C
 - .2 Space Temperature High = 22°C; SA Setpoint High = 22°C
 - .2 The AHU-3 shall modulate the amount of outside air allowed into the unit to satisfy space CO2 levels. The system shall measure the CO2 concentration within the return air duct and maintain the CO2 concentration to be no greater than 400ppm above atmospheric levels measured on site.
- .6 AC-1:
- .1 AC-1 shall be enabled from the BAS according to a 7-day schedule. Controls contractor is to obtain operation schedule from Departmental Representative.
 - .2 When AC-1 is scheduled to be on, the supply fan shall run continuously and the outside air damper shall be open.
 - .3 The unit shall modulate its cooling output to satisfy the space temperature within Room C120. As the space temperature falls below setpoint, the BAS shall modulate RH-6 heating valve to maintain the space temperature.
 - .4 The heating coil within AC-1 shall be modulated by the BAS to maintain the heating setpoint with room C115.
 - .5 Heating and cooling setpoint shall be adjustable from the BAS.

- .6 When AC-1 is scheduled to be off, the outside air damper shall be closed.
- .7 The BAS shall generate an alarm if the supply fan fails to operate when AC-1 is scheduled to be 'on'.
- .8 Isolation Room:
 - .1 When AC-1 is in operation, the supply air damper that serves the isolation room shall open and the EF-21 shall turn on.
 - .2 The heating coil valve (RH-8) and the humidifier shall modulate to maintain the humidity and temperature setpoints of the isolation room. Refer to 1.7.2.9 below for Isolation Room Setpoints.
 - .3 The humidifier shall have an air proving switch and high humidity sensor located within the supply air ductwork. The humidifier shall not operate unless proof of AC-1 supply fan operation is available. The high humidity limit in the ductwork downstream of the humidifier shall be set at 80%RH and disable the humidifier if it is reached.
- .7 Split AC systems (AC-2 through 19):
 - .1 Each split AC system shall be enabled from the BAS according to a 7-day schedule. Controls contractor is to obtain operation schedule from Departmental Representative.
 - .2 Once enabled from the BAS, the AC system shall operate via the unit's local controller.
 - .3 The BAS shall monitor the unit status and space temperature. Space temperature setpoints shall be adjustable from the BAS.
- .8 Exhaust Fans and Unit Heaters
 - .1 Exhaust fans and unit heaters are to be enabled from the BAS.
 - .2 The exhaust fans shall operate to maintain space temperatures below the cooling setpoint. The cooling setpoint shall be adjustable from the BAS and initially programmed to be 25°C.
 - .3 The exhaust fans shall be interlocked with the supply air and exhaust air motorized dampers. Dampers shall open when the exhaust fan is on and close when the exhaust fan is off.
 - .4 Unit heaters shall operate to maintain space temperatures above the heating temperature setpoint. The heating setpoint shall be adjustable from the BAS and initially programmed to be 18°C.
 - .5 The BAS shall generate an alarm if any space served solely by a unit heater or exhaust fan raises above 30°C or drops below 10°C.
- .9 Isolation Room
 - .1 The BAS is to monitor the temperature, humidity, and relative pressure of the isolation room and alarm the operator if the current conditions exceed the setpoints. The setpoints shall be as follows:
 - .1 Temperature = 22°C - 24°C
 - .2 Humidity = 30%RH – 60%RH
 - .3 Differential pressure – 5Pa, minimum between adjacent Anteroom.

- .3 Sequences of operations for Systems within the SLE Building are as follows (LCM-12 to LCM-13, LCM-14, and LCM-15):
 - .1 HRV-1 and HC-1:
 - .1 HRV-1 shall be scheduled from the BAS to run continuously.
 - .2 Supply air temperature sensor shall modulate the three way valve to maintain a 20°C supply air temperature (adjustable).
 - .3 An alarm will be sent to the BAS if the supply air temperature drops below 17°C.
 - .4 An alarm will be sent to the BAS if the HC-1 return water temperature drops below 10°C.
 - .2 UH-401:
 - .1 Unit heater to be enabled by the BAS.
 - .2 Unit heater fan shall operate when space temperature reaches 17°C (Adjustable from BAS). When unit heater fan is operating to maintain heating setpoint, two-way valve shall open to allow hot water to flow. When setpoint is satisfied the two way valve shall close and the unit heater fan shall turn off.
 - .3 An alarm shall be sent to the BAS if the space temperature is 12°C.
 - .3 Domestic Hot Water:
 - .1 The domestic hot water pump, CP-304 shall be enabled by the BAS based on a 7-day schedule. Obtain operational schedule from Departmental Representative.
 - .2 When pump CP-304 is scheduled to be on, the three way valve shall modulate to maintain a domestic hot water supply temperature of 49°C.
 - .3 An alarm shall be sent to the BAS of the domestic hot water supply temperature exceeds 60°C.
 - .4 Radiant Floor Heating:
 - .1 Pump CP-303 shall operate whenever a radiant zone valve is open.
 - .2 Hot water supply temperature for radiant heating shall be reset based on outside air temperature. The radiant heating three way valve shall modulate to maintain the supply temperature according to the following schedule.
 - .1 OA High = 10°C; HWS High = 32.2°C
 - .2 OA Low = -20°C; HWS Low = 60°C
 - .3 Radiant floor heating shall be disabled through the BAS at outside air temperatures of 20C or above (Adjustable from BAS).
 - .4 Radiant zone valves shall open and close to maintain space temperature as sensed by local zone space temperature sensor. Temperature sensors located within inmate areas shall not have local temperature adjustment and shall only have their setpoints adjusted through the BAS.
 - .5 Temperature sensors located within staff areas shall not have local temperature adjustment and shall only have their setpoints adjusted through the BAS.

- .6 Radiant floor zones that have slab temperature sensors shall monitor slab temperature. Zone valves shall on/close to maintain space temperatures and to not exceed a slab temperature of 32.2°C.
 - .7 Local circulator pumps provided for zones Z22 through Z25 shall be enabled whenever one of the associated zone valves open.
 - .5 FCU-401:
 - .1 Fan coil unit FCU-401 shall be enabled through BAS.
 - .2 FCU-401 shall run continuously based on a time of day schedule from the BAS. Obtain the operational schedule from the Departmental Representative.
 - .3 Mechanical cooling shall be enabled to maintain a space temperature of 24°C (adjustable from BAS)
 - .6 Heating System:
 - .1 Boilers shall be enabled from the BAS.
 - .2 On a call for heat, primary heating water pump CP-301 shall be enabled. The boilers shall not operate unless CP-301 is proven on by line mounted flow switch.
 - .3 Boilers shall be staged to maintain a primary loop return water temperature of 60C (adjustable from BAS). The lead boiler shall be rotated on the first day of every month.
 - .4 Hot water supply temperature shall be reset as required to satisfy the load. A supply water high limit shall be 82C (Adjustable from BAS).
 - .5 An alarm shall be sent to the BAS if there is a call for heat and flow is not established for CP-301.
 - .6 Pump CP-302 shall operate continuously.
 - .7 RTU-1:
 - .1 RTU-1 shall be enabled from the BAS according to a 7-day schedule. Controls contractor is to obtain operation schedule from Departmental Representative.
 - .2 When enabled, supply fan for RTU-1 shall operate continuously.
 - .3 Heating and cooling shall be staged to maintain space temperature setpoint of 24°C in cooling and 20°C in heating (adjustable from BAS).
 - .4 Alarm conditions generated from RTU-1 onboard controller shall be sent to the BAS.
 - .8 AC-1:
 - .1 AC-1 shall be enabled from the BAS.
 - .2 The BAS shall provide a space temperature setpoint AC-1.
 - .3 AC-1 shall modulate under control of its local controller to maintain space temperature.
 - .4 Sequences of operations for Systems within the Intensive Intervention Unit (IIU) are as follows (Microzone 13-21):
 - .1 Heating Plant:
 - .1 Boilers B-1 and B-2 shall operate in sequence to maintain 80°C supply water temperature (adjustable from BAS).
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- .2 Prior to each boiler starting, its associated pump, P-1 or P-2, shall start and their operation shall be proven prior to starting the boiler.
- .3 An alarm shall be generated at the BAS if the supply water temperature falls below 60°C.
- .4 An alarm shall be generated at the BAS if a boiler fails to operate.
- .2 Domestic Hot Water System:
 - .1 Pumps P-3 and P-4 are constant speed duty/standby pumps. One pump shall run continuously. When one pump fails the other shall be started. Rotate pumps on a weekly basis for even wear.
 - .2 An alarm shall be generated at the BAS in the event that P-3 or P-4 fails.
 - .3 Pumps P-9 and P-10 are constant speed duty/standby pumps. One pump shall run continuously. When one pump fails the other shall be started. Rotate pumps on a weekly basis for even wear.
 - .4 An alarm shall be generated at the BAS in the event that P-9 or P-10 fails.
 - .5 Domestic hot water system 3-way valve to open/close to maintain 50°C domestic hot water temperature.
 - .6 The domestic hot water re-circulation pump, P-11 shall be scheduled to operate from the BAS according to a 7-day schedule. Obtain the operating schedule from the Departmental Representative.
 - .7 An alarm shall be generated at the BAS in the event that P-11 fails to operate when scheduled to be on.
 - .8 Domestic hot water storage tank temperature to be hard wired to shut off pumps P-9 and P-10 and send an alarm to the BAS should the tank temperature exceed 60°C.
- .3 Heating Coil Loop:
 - .1 Pumps P-5 and P-6 are constant speed duty/standby pumps. One pump shall run continuously when scheduled. When one pump fails the other shall be started. Rotate pumps on a weekly basis for even wear.
 - .2 An alarm shall be generated at the BAS in the event that P-5 or P-6 fails.
 - .3 Pumps P-5 and P-6 are to be scheduled based on outside air. Pumps to be enabled whenever outside air temperature is below 15°C (adjustable from BAS).
 - .4 The temperature of the heating coil loop shall be reset based on outside air temperature. The reset schedule shall be as follows:
 - .1 OA Low = -18°C; HWS Low = 80°C
 - .2 OA High = 18°C; HWS High = 35°C.
 - .5 When the outside air temperature is above 20°C, the 3-way valve shall be in full bypass mode.
- .4 Radiant Floor Heating:
 - .1 Heating shall be initiated by remote sensors located within the occupied spaces. The heating setpoint shall be adjustable from the BAS.
 - .2 On a call for heating the radiation floor heating pump shall be started. Pumps P-7 and P-8 are constant speed duty/standby pumps. When one pump fails the other shall be started. Rotate pumps on a weekly basis for even wear.

- .3 An alarm shall be generated at the BAS in the event that P-7 or P-8 fails.
- .4 Radiant floor manifold valves shall open/close in order to satisfy the corresponding zone request for heating.
- .5 Radiant floor heating loop hot water supply temperature shall be reset based on outside air temperatures. The outside air temperature reset schedule shall be as follows:
 - .1 OA Low = -10°C; HWS Low = 49°C
 - .2 OA High = 18°C; HWS High = 32°C.
- .6 When the outside air temperature is above 20°C, the 3-way valve shall be in full bypass mode.
- .7 A temperature sensor shall be installed downstream of the pumps to shut down pumps P-7 and P-8 in the event that the radiant floor hot water supply temperature exceeds 55°C. An alarm shall be generated at the BAS if the water reaches this temperature.
- .5 Air Conditioning Units AC-1 and AC-2:
 - .1 The BAS shall enable each air conditioning unit based on a user defined 7-day operation schedule. Controls contractor to obtain schedule from Departmental Representative.
 - .2 The BAS shall operate the heating control valves and the condensers/economizers to maintain temperature setpoint (adjustable from BAS).
 - .1 On a call for heating, the heating valve shall be modulated open. The supply air discharge temperature shall be limited to 32°C.
 - .2 On a call for cooling, the BAS shall control the condensers or the economizer to maintain space temperature setpoint.
 - .1 Mechanical cooling shall be locked out at outside air temperatures less than 10°C or whenever the economizer is in operation.
 - .2 When outside conditions are favorable for free cooling, the outside air economizer shall modulate to maintain space temperature setpoint.
 - .3 When outside conditions are unfavorable for free cooling, the condenser shall be enabled and mechanical cooling shall be utilized to maintain space temperature setpoint.
 - .3 While in heating or utilizing mechanical cooling, the outside air damper shall be in the minimum position.
 - .3 When the air conditioning unit is scheduled to be off, the outside air damper shall be closed. The unit shall only cycle on to maintain space temperature setpoint. Minimum run-time of the unit when cycled on shall be 15 minutes (adjustable from BAS).
 - .4 The BAS shall generate an alarm if the supply fans fail to start when commanded.
 - .5 The BAS shall generate an alarm if the supply air temperature of the air conditioning unit falls below 10°C.

- .6 The BAS shall generate an alarm at the BAS if smoke is detected in the air stream.
 - .6 Air Conditioning Unit AC-3:
 - .1 The BAS shall enable the air conditioning unit.
 - .2 The unit shall cycle to maintain space temperature setpoint. The setpoint shall be 25°C (Adjustable from BAS).
 - .3 The BAS shall generate an alarm if the status of the supply fan fails when the unit is on.
 - .4 The BAS shall generate an alarm if the temperature in the elevator machine room (AC-3) raises above 30°C.
 - .7 Air Handling Unit AHU-1:
 - .1 The BAS shall enable the AHU based on a user defined 7-day operation schedule. Controls contractor to obtain schedule from Departmental Representative.
 - .2 When the unit is enabled, the onboard control shall open the fresh air intake and exhaust air control dampers. Upon confirmation that the dampers are open (via limit switches), the supply fan shall start. The return fan shall be interlocked with the supply fan to start at the same time.
 - .3 The BAS shall modulate the heating control valve to maintain the discharge air temperature, initially set at 18°C. (adjustable from BAS).
 - .4 Control valves for heating coils HC-3, HC-4, HC-5 shall be modulated from the BAS to maintain space temperature setpoints (adjustable from BAS).
 - .5 When the outdoor air temperature is between 10°C and 22°C, the BAS will force the heat reclaim control to full bypass (exhaust) mode so that no reclaim is occurring.
 - .6 When the unit is scheduled to be off, the supply and return fans shall be off and the motorized dampers in the unit shall be closed.
 - .7 When the unit is scheduled to be off and the space temperatures of any of the three areas served by the reheat coils HC-3, HC-4, or HC-5 drop below 16°C, the unit shall be started. The outside air and exhaust air dampers shall remain closed and the unit shall re-circulate air until the temperatures of the spaces are 18°C. The minimum run time of the unit shall be 15 minutes.
 - .8 The BAS shall monitor the status of the supply and return fans and generate an alarm if either of the fans fail.
 - .9 The BAS shall generate an alarm if the supply air temperature falls below 10°C.
 - .10 The BAS shall generate an alarm at the BAS if smoke is detected in the air stream.
 - .8 Unit Heaters and Cabinet Heaters:
 - .1 The BAS shall enable the equipment.
 - .2 The BAS shall cycle the equipment on/off to maintain space temperature setpoint (adjustable from BAS). The initial 'on' temperature shall be 18°C, and the 'off' temperature shall be 20°C.
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- .3 The BAS shall generate an alarm if the space temperature drops below 10°C.
 - .9 Exhaust Fans and Unit Heaters:
 - .1 The BAS shall enable the equipment.
 - .2 The BAS shall monitor the local space sensor and energize the exhaust fan if the space temperature rises above the cooling setpoint, initially set at 25°C. The BAS shall energize the unit heater if the space temperature falls below the heating setpoint, initially set at 18°C. The setpoints shall be adjustable from the BAS.
 - .3 The BAS shall generate an alarm if the space temperature exceeds 30°C or falls below 10°C.
 - .10 Kitchen Exhaust Fans EF-1 and EF-6.
 - .1 Make-up air for the kitchen exhaust system is provided through AC-2. EF-1 and EF-6 are enabled by the BAS only when AC-2 is operating.
 - .2 EF-1 and EF-6 shall be manually started and stopped.
 - .3 Motorized damper MD-3 is interlocked with EF-1 and EF-6 such that when either EF-1 or EF-6 is activated, MD-3 is driven closed.
 - .4 Fire suppression system shall be interlocked to shut down the fans upon activation by DIV. 26.
 - .11 Air Conditioning Unit AC-6:
 - .1 The BAS shall enable AC-6 based on a user defined 7-day operation schedule. Controls contractor to obtain schedule from Departmental Representative.
 - .2 AC-6 shall utilize it's local controller to maintain space temperatures within the cooling setpoint. The BAS shall modulate the heating valve to maintain the space temperature within the heating setpoint. The discharge supply air temperature shall be limited to 32°C
 - .3 Motorized damper MD-4 is to be interlocked with the operation of AC-6 in such a way to be open when AC-6 is on and closed when AC-6 is off.
 - .4 The BAS shall generate an alarm if AC-6 is scheduled to operate and the supply fan does not operate.
 - .5 Sequences of operations for Systems within the MCCP Unit are as follows:
 - .1 The BAS shall enable MCCP-CU system, MCCP-CU-1, EF-4N and SF-1N based on a user defined 7-day operation schedule. Schedule to be initially programmed for 24/7 operation.
 - .2 When the BAS schedules the equipment to be 'on' or when the emergency override button is pressed, the outside air damper shall open and SF-1N shall be turned on. Once the operation of SF-1N is proven, EF-4N shall start.
 - .3 During normal operation, the supply fan and exhaust fan shall run continuously. The supply fan shall operate on low speed. The duct heater will modulate according to its local controller to maintain a minimum supply air temperature of 15.6°C. The humidifier shall modulate it's output to maintain a space humidity of 40% RH at all times.
 - .4 When the emergency button is pressed at the local emergency panel, the system shall go into emergency mode.
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- .1 The supply fan shall operate at high speed for a period of 1 hour. The time delay is adjustable from the BAS.
- .2 The indicator light on the emergency panel shall illuminate to indicate the operational status of the supply fan.
- .3 The exhaust fan shall operate continuously.
- .5 The split AC systems shall operate via their local controllers to maintain space temperature setpoint (adjustable from the BAS).
- .6 When the systems are scheduled to be 'off', SF-1N and EF-4N shall be off and the outside air damper shall be closed.
- .7 The base board heater shall be enabled from the BAS. The heater shall modulate its output to maintain the space above its heating setpoint. The heating setpoint is adjustable from the BAS, initially set at 18°C.
- .8 The BAS shall generate an alarm if the emergency panel button is pressed.
- .9 The BAS shall generate an alarm if the space temperature exceeds 30°C or falls below 10°C.

1.8 PEB SEQUENCES OF OPERATIONS

- .1 Present sequencing of operations for system(s), in accordance with MD 250005 - 2009 Energy Monitoring and Control Systems (EMCS) Design Guidelines and as indicated in this section.
- .2 Sequencing of operations for systems as follows:
 - .1 Constant Volume Bypass Box
 - .1 The following sequence is to achieve cooling with reheat control.
 - .2 On a rise in room temperature the thermostat energizes the actuator. The actuator slowly rotates the damper shaft to increase the volume of cold air to the room.
 - .3 On a fall in room temperature, the thermostat reverses the above action. The actuator slowly rotates the damper shaft to decrease the cold air to the room to a preset minimum.
 - .4 If the room temperature continues to fall, the thermostat activates the control relay of the heating coil.
 - .5 Temperature setpoint shall be adjustable from the BAS.
 - .2 Variable Volume Diffusers.
 - .1 Variable volume diffusers shall modulate damper position in response to room temperature.
 - .2 With a rise in room temperature, VAV diffuser shall modulate open to allow additional airflow into the room.
 - .3 With a fall in room temperature, VAV diffuser shall modulate closed to reduce the airflow into the room.
 - .4 Minimum flow setting of VAV diffuser shall never be less than 30% of design cooling airflow.
 - .5 Temperature setpoint shall be adjustable from the BAS.
 - .3 Inline Exhaust Fans

- .1 Inline exhaust fans to be controlled by local inline switches.
- .2 EF-1 control switch to be complete with 60 minute timer to automatically turn fan off.
- .3 All exhaust fans to be interlocked with their corresponding control dampers. Control dampers to be normally open.
- .4 BAS to alarm operator when EF-2 or EF-3 are in operation.
- .4 Sump Pump
 - .1 Sump pump run time to be tracked on BAS
 - .2 BAS to generate an alarm when sump pit high level alarm is activated.
 - .3 BAS to generate an alarm when sump pump detects oil within the sump pit.
- .5 Condenser Loop
 - .1 Condenser water pumps shall be enabled from the BAS.
 - .2 Variable speed drive shall continuously scan and compare condenser loop pressure sensor to its individual setpoint and modulate speed of condenser water pumps to maintain setpoint.
 - .3 If the setpoint cannot be satisfied by the lead pump, the variable speed drive shall initiate a timed sequence of events to stage a lag pump.
 - .4 When the set point criteria can be safely satisfied with one pump, the pump controller shall initiate a destaging sequence and continue variable speed operation.
 - .5 In the event of a system differential pressure failure due to a pump or overload fault, the variable speed drive shall automatically start the remaining pump set in the variable speed mode.
 - .6 BAS shall automatically rotate lead pump on the weekly basis.
 - .7 Condenser loop heating and cooling setpoint to be user adjustable. Heating setpoint to be initially set at 20°C. Cooling setpoint to be initially set at 43°C.
 - .8 Boiler and Dry cooler to enable to maintain condenser loop within the heating and cooling setpoints.
 - .1 Dry Cooler:

- .1 Dry cooler three-way valve to modulate open to maintain condenser loop return temperature below setpoint.
 - .2 Dry cooler factory installed controller to stage fans in sequence to maintain dry cooler leaving water temperature setpoint. Dry cooler controller to accept leaving water temperature setpoint from BAS.
 - .3 Dry cooler to be disabled unless flow is proven from flow switch mounted in dry cooler supply piping.
 - .4 BAS to generate an alarm in the event three way valve is open and flow switch does not prove true.
 - .5 If dry cooler status has not been 'ON' for a period of 24 hours, three-way valve for dry cooler to modulate open to 100% for a duration of 5 minutes to circulate fluid through the dry cooler. This sequence shall be measured from 1400hours.
- .2 Boilers:
- .1 Boilers shall modulate on in sequence based on the manufacturer's stand along controls to maintain condenser loop supply temperature above setpoint.
 - .2 BAS system to provide boilers with supply water temperature setpoint necessary to maintain condenser loop heating setpoint.
 - .3 BAS to generate an alarm to the operator whenever the boilers go into an alarm.
- .9 BAS to generate an alarm if condenser loop heating and cooling setpoints are exceeded.
- .6 Humidifier
- .1 Humidifier shall accept a signal from the BAS of the supply air relative humidity and modulate its capacity to maintain the relative humidity setpoint as measured from the return air duct.
 - .2 Humidity setpoint shall be user adjustable. Initial setting to be 30%RH at 22°C.
 - .3 Safety Controls:
 - .1 Humidifier shall not enable unless air flow is proven from duct mounted air flow switch.
 - .2 Humidifier output shall be limited to not exceed a supply air relative humidity of 85%.
 - .3 BAS to generate an alarm when humidifier goes into a fault.
- .7 Glycol Feed System
- .1 BAS to generate an alarm when low level signal is received from glycol feed system.
- .8 VRF System
- .1 Program temperature setpoints and time of operation for individual fan coils. Obtain times of operation and room setpoints from Departmental representative.

- .2 Maintain at least a 3°C temperature dead-band between heating and cooling setpoints.
- .3 Program temperature setbacks of 28°C in cooling and 18°C in heating for non-occupied times.
- .4 Ensure any alarms generated by VRF control program are also annunciated within the main BAS control program.
- .5 VRF system shall control devices based on internal control program.
- .9 Forced Air Heaters
 - .1 Forced air heaters are to be enabled through the BAS.
 - .2 Space temperatures are to be user adjustable from BAS. Forced air heaters to turn on to maintain minimum space temperatures.
 - .1 Vestibules and Exits = 18°C
 - .2 Washrooms and Lockers = 22°C
- .10 Dedicated Outside Air System
 - .1 DOAS shall be programmed to be operated on a time of day schedule. During occupancy the DOAS shall operate in “Occupied Mode” and during periods of no occupancy operate in “Unoccupied Mode”.
 - .2 Occupied Mode – When the unit is scheduled to be in occupied mode, the energy recovery wheel shall start rotating, the exhaust air damper opens, the outside air damper opens. After the exhaust air damper opens the exhaust blower shall start. After the outside air damper opens the supply blower shall start. The unit shall modulate the wheel and water source heat pump in sequence to maintain the supply air temperature setpoint.
 - .3 Unoccupied Mode – When the unit is scheduled to be in unoccupied mode the exhaust blower will stop and the outside air blower will stop. The exhaust air damper and the supply air damper will close and the enthalpy wheel will stop rotating. Unit will turn off.
 - .4 Variable Free Cooling – If the outside air temperature is above the summer setpoint (selectable) and the outside air temperature is less than the return air temperature, and less than the supply air temperature, the wheel modulates to the wheel leaving temperature setpoint.
 - .5 Cooling – If the outside air temperature is above the summer setpoint (selectable) and if the coil leaving air temperature rises above the coil leaving air temperature setpoint (selectable) the water source heat pump compressor will start. Compressor will modulate to maintain coil leaving air temperature setpoint.
 - .6 Heating – If the outside air temperature is below summer setpoint (selectable) and if the coil leaving air temperature is below heating setpoint, the water source heat pump compressor will start. Compressor will modulate to maintain coil leaving air temperature setpoint.
 - .7 Water Source Heat Pump Two-Way Valve – On a call for compressor operation, two-way (on/off) valve for condenser water shall open. Two-way (on/off) valve shall close when compressors are off. Valve shall be normally open.

- .8 Preheat Frost Prevention – If the outside air temperature is below the front control setpoint (selectable), frost control is enabled. The preheat valve shall modulate to maintain the frost control setpoint.

1.9 IFSS I/O POINT INTEGRATION

- .1 The existing I/O points for the IFSS are provided here for information purposes. Existing controllers, points, and sequences for the IFSS are to be reused and integrated into the new OWS.
- .2 The existing IFSS is a Johnson Controls FX Supervisory controller operating on the Tridium Niagara Software using the BACnet/IP communication protocol. It is connected to the GVI LAN.
- .3 Integrate existing Institutional Food Services and Stores Building (IFSS) BAS onto the new BAS.
- .1 Existing controllers and devices are to be reused.
- .2 Contractor is to map existing points to new OWS
- .3 Sequences and programming of the existing IFSS controllers is to remain as existing.

Object List	Object Type	Alarm (Y/N)	Trend (Y/N)	Units
FCU-1 Enable/Disable	DO	N	Y	ON/OFF
FCU-1 Status	DI	N	Y	ON/OFF
FCU-1 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-1 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-1 Zone Temperature	AI	N	Y	DEGREE C
FCU-1 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-1 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-1 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-2 Enable/Disable	DO	N	Y	ON/OFF
FCU-2 Status	DI	N	Y	ON/OFF
FCU-2 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-2 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-2 Zone Temperature	AI	N	Y	DEGREE C
FCU-2 Zone Temperature	AO	N	Y	DEGREE C

Setpoint				
FCU-2 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-2 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-3 Enable/Disable	DO	N	Y	ON/OFF
FCU-3 Status	DI	N	Y	ON/OFF
FCU-3 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-3 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-3 Zone Temperature	AI	N	Y	DEGREE C
FCU-3 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-3 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-3 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-4 Enable/Disable	DO	N	Y	ON/OFF
FCU-4 Status	DI	N	Y	ON/OFF
FCU-4 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-4 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-4 Zone Temperature	AI	N	Y	DEGREE C
FCU-4 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-4 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-4 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-5 Enable/Disable	DO	N	Y	ON/OFF
FCU-5 Status	DI	N	Y	ON/OFF
FCU-5 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-5 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-5 Zone Temperature	AI	N	Y	DEGREE C
FCU-5 Zone Temperature	AO	N	Y	DEGREE C

Setpoint				
FCU-5 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-6 Enable/Disable	DO	N	Y	ON/OFF
FCU-6 Status	DI	N	Y	ON/OFF
FCU-6 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-6 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-6 Return Temperature	AI	N	Y	DEGREE C
FCU-6 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-6 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-7 Enable/Disable	DO	N	Y	ON/OFF
FCU-7 Status	DI	N	Y	ON/OFF
FCU-7 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-7 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-7 Zone Temperature	AI	N	Y	DEGREE C
FCU-7 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-7 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-8 Enable/Disable	DO	N	Y	ON/OFF
FCU-8 Status	DI	N	Y	ON/OFF
FCU-8 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-8 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-8 Zone Temperature	AI	N	Y	DEGREE C
FCU-8 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-8 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-9 Enable/Disable	DO	N	Y	ON/OFF
FCU-9 Status	DI	N	Y	ON/OFF
FCU-9 Cooling Coil	AO	N	Y	0-100%

Valve Position				
FCU-9 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-9 Zone Temperature	AI	N	Y	DEGREE C
FCU-9 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-9 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-10 Enable/Disable	DO	N	Y	ON/OFF
FCU-10 Status	DI	N	Y	ON/OFF
FCU-10 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-10 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-10 Return Temperature	AI	N	Y	DEGREE C
FCU-10 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-10 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-11 Enable/Disable	DO	N	Y	ON/OFF
FCU-11 Status	DI	N	Y	ON/OFF
FCU-11 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-11 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-11 Zone Temperature	AI	N	Y	DEGREE C
FCU-11 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-11 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-11 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-12 Enable/Disable	DO	N	Y	ON/OFF
FCU-12 Status	DI	N	Y	ON/OFF
FCU-12 Cooling Coil Valve Position	AO	N	Y	0-100%

FCU-12 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-12 Zone Temperature	AI	N	Y	DEGREE C
FCU-12 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-12 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-12 Mode of Operation	LOGIC	N	Y	Heating/Cooling
FCU-13 Enable/Disable	DO	N	Y	ON/OFF
FCU-13 Status	DI	N	Y	ON/OFF
FCU-13 Cooling Coil Valve Position	AO	N	Y	0-100%
FCU-13 Heating Coil Valve Position	AO	N	Y	0-100%
FCU-13 Zone Temperature	AI	N	Y	DEGREE C
FCU-13 Zone Temperature Setpoint	AO	N	Y	DEGREE C
FCU-14 Radiant Panel Valve Position	AO	N	Y	0-100%
FCU-15 Mode of Operation	LOGIC	N	Y	Heating/Cooling
Outside Air Temperature	AI	N	Y	DEGREE C
Outside Air Relative Humidity	AI	N	Y	% RH
Exhaust Fan RF-1 Enable/Disable	DO	N	Y	ON/OFF
Exhaust Relative Humidity	AI	N	Y	% RH
Outside Air Temperature Sensor	AI	N	Y	DEGREE C
Damper 1	AI	N	Y	OPEN/CLOSED
Dirty Filter Alarm	AI	Y	Y	ALARM/ NORMAL
Outside Air Relative Humidity	AI	N	Y	% RH
Temperature Sensor 3	AI	N	Y	DEGREE C

Freeze Stat	DI	Y	Y	ALARM/ NORMAL
Heating Coil Valve Position	AO	N	Y	0-100%
Cooling Coil Valve Position	AO	N	Y	0-100%
Supply Fan Enable/Disable	DO	N	Y	ON/OFF
Supply Fan Speed	AO	N	Y	0-100%
Supply Air Flow	AI	N	Y	L/S
Humidification Capacity	AO	N	Y	0-100%
Supply Air Temperature	AI	N	Y	DEGREE C
Supply Air Humidity	AI	N	Y	% RH
Supply Air Pressure Setpoint 2/3rd	AI	N	Y	Pascals
Boiler System Enable/Disable	DO	N	Y	ON/OFF
Boiler Reset Temperature	AI	N	Y	DEGREE C
Boiler Alarm	DI	Y	Y	ALARM / NORMAL
Hot water Flow Rate	AI	N	Y	L/S
Pressure Transducer 1	AI	N	Y	Kilo Pascals
Pump P-4 Enable	DO	N	Y	ON/OFF
Pump P-4 Status	DI	N	Y	ON/OFF
Pump P-5 Enable	DO	N	Y	ON/OFF
Pump P-5 Status	DI	N	Y	ON/OFF
Pump P-6 Enable	DO	N	Y	ON/OFF
Pump P-6 Status	DI	N	Y	ON/OFF
Hot Water Supply Temperature	AI	N	Y	DEGREE C
Hot Water Return from HX-1	AI	N	Y	DEGREE C
Hot Water Return from Radiant Slab	AI	N	Y	DEGREE C
Hot Water Return from Fan Coils	AI	N	Y	DEGREE C
Hot Water Return	AI	N	Y	DEGREE C
Pressure Bypass Valve V5	AO	N	Y	0-100%

Differential Pressure Sensor	AI	N	Y	Kilo Pascals
Expansion Tank 1 Pressure Sensor	AI	N	Y	Kilo Pascals
Heating Valve V7	AO	N	Y	0-100%
Pump P-7 Enable	DO	N	Y	ON/OFF
Pump P-7 Status	DI	N	Y	ON/OFF
Pump P-8 Enable	DO	N	Y	ON/OFF
Pump P-8 Status	DI	N	Y	ON/OFF
Expansion Tank 2 Pressure Sensor	AI	N	Y	Kilo Pascals
Heating Valve V2	AO	N	Y	0-100%
Heating Valve V1	AO	N	Y	0-100%
Glycol Temperature Sensor 1	AI	N	Y	DEGREE C
Glycol Temperature Sensor 2	AI	N	Y	DEGREE C
Glycol Temperature Sensor 3	AI	N	Y	DEGREE C
Pump P-9 Enable	DO	N	Y	ON/OFF
Pump P-9 Status	DI	N	Y	ON/OFF
Pump P-10 Enable	DO	N	Y	ON/OFF
Pump P-10 Status	DI	N	Y	ON/OFF
Chilled water Flow Rate	AI	N	Y	L/S
Chilled Water Supply Temperature	AI	N	Y	DEGREE C
Differential Pressure Sensor	AI	N	Y	Kilo Pascals
Pressure Bypass Valve V10	AO	N	Y	0-100%
Chilled Water Return Temperature	AI	N	Y	DEGREE C
Chilled Water Return Temperature from Fancoils and Slab	AI	N	Y	DEGREE C
Chilled Water Return Temperature from DOAS	AI	N	Y	DEGREE C
Slab Switch Over	DO	N	Y	HEAT/COOL
Switch Over Valve V3	AO	N	Y	HEAT/COOL
Switch Over Valve V3	AO	N	Y	HEAT/COOL

Mixing Valve V5	AO	N	Y	0-100%
Pump P-11 Enable	DO	N	Y	ON/OFF
Pump P-11 Status	DI	N	Y	ON/OFF
Slab Supply Temperature	AI	N	Y	DEGREE C
Manifold 1 Slab Temperature	AI	N	Y	DEGREE C
Manifold 1 Zone Temperature	AI	N	Y	DEGREE C
Manifold 1 Zone Humidity	AI	N	Y	% RH
Manifold 1 Zone Setpoint	AO	N	Y	DEGREE C
Manifold 1 Valve Command	DO	N	Y	OPEN/CLOSED
Manifold 2 Slab Temperature	AI	N	Y	DEGREE C
Manifold 2 Zone Temperature	AI	N	Y	DEGREE C
Manifold 2 Zone Humidity	AI	N	Y	% RH
Manifold 2 Zone Setpoint	AO	N	Y	DEGREE C
Manifold 2 Valve Command	DO	N	Y	OPEN/CLOSED
Manifold 3 Slab Temperature	AI	N	Y	DEGREE C
Manifold 3 Zone Temperature	AI	N	Y	DEGREE C
Manifold 3 Zone Humidity	AI	N	Y	% RH
Manifold 3 Zone Setpoint	AO	N	Y	DEGREE C
Manifold 3 Valve Command	DO	N	Y	OPEN/CLOSED
Manifold 4 Slab Temperature	AI	N	Y	DEGREE C
Manifold 4 Zone Temperature	AI	N	Y	DEGREE C
Manifold 4 Zone Humidity	AI	N	Y	% RH
Manifold 4 Zone Setpoint	AO	N	Y	DEGREE C
Manifold 4 Valve Command	DO	N	Y	OPEN/CLOSED
Manifold 5 Slab	AI	N	Y	DEGREE C

Temperature				
Manifold 5 Zone Temperature	AI	N	Y	DEGREE C
Manifold 5 Zone Humidity	AI	N	Y	% RH
Manifold 5 Zone Setpoint	AO	N	Y	DEGREE C
Manifold 5 Valve Command	DO	N	Y	OPEN/CLOSED

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements that are common to NMS sections found in Division 26 – Electrical, 27 – Communications, 28 - Electronic Safety and Security.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.1-2012, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .3 Do underground systems in accordance with CSA C22.3 No.7-06, Underground Systems, except where specified otherwise.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 The Ontario Electrical Safety Code 2012, and all bulletins (Ontario).
- .5 Hydro requirements and local applicable codes and regulations.

1.3 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate for both languages.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
 - .2 Product Data: submit WHMIS MSDS.
 - .3 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.
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- .4 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .5 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario within 3 weeks of Award of Contract.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 If changes are required, notify Departmental Representative and Engineer of these changes before they are made.
- .6 Quality Control: in accordance with Section 01 45 00.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to Provincial 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. Pay associated fees. Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.
 - .6 Submit certificate of acceptance from ESA 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.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

- .3 Site Meetings:
 - .1 In accordance with Section 01 31 19.
 - .2 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete or as directed by Departmental Representative.
 - .3 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.7 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.

1.8 OPERATING INSTRUCTIONS

- .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.
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- .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.

Part 2 PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Section 01 61 00.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction and inspection authorities before delivery to site and submit such approval as described in PART 1 - Submittals.
- .3 Factory assemble control panels and component assemblies.

2.3 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 01 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.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and inspection authorities and Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm or as directed by Departmental Representative.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamacoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high
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Size 2	letters 12 x 70 mm	1 line	5 mm high
Size 3	letters 12 x 70 mm	2 lines	3 mm high
Size 4	letters 20 x 90 mm	1 line	8 mm high
Size 5	letters 20 x 90 mm	2 lines	5 mm high
Size 6	letters 25 x 100 mm	1 line	12 mm high
Size 7	letters 25 x 100 mm	2 lines	6 mm high

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate / label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.
- .9 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .10 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .11 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .12 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .13 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. " as directed by Departmental Representative .
- .14 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .15 Terminal cabinets and pull boxes: indicate system and voltage.
- .16 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA-C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 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 15m intervals.
- .3 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

	<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	Green	Blue

Communication

Systems

Fire Alarm Red

Emergency Red Blue

Voice

Other Red Yellow

Security

Systems

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA-C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel 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 to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm 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 door.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
 - .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
 - .3 Install electrical equipment at following heights unless indicated otherwise.
-

- .1 Local switches: 1200 mm to center line maximum in accordance with CSA-B651-12
- .2 Wall receptacles:
 - .1 General: 400 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: 400 mm.
- .5 Wall mounted telephone and interphone outlets for non-accessible locations: 1500 mm.
- .6 Fire alarm stations: 1200 mm to center line maximum in accordance with CSA-B651-12
- .7 Fire alarm bells: 2100 mm.
- .8 Television outlets: 400 mm.
- .9 Wall mounted speakers: 2100 mm.
- .10 Clocks: 2100 mm.
- .11 Door bell pushbuttons: 1200 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 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 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, security, 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 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .6 Verification requirements include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.8 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .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)

1.2 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.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .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 and in accordance with Section 02 42 93.
- .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 02 42 93.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2, NEMA to consist of:
 - .1 Connector body and stud clamp for round copper conductors.
 - .2 Clamp for round copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of 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.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2, NEMA.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
-

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return of pallets ,crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10AWG and larger. Minimum size: 12AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: PVC flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

2.3 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath : thermoplastic jacket.

Part 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .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.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 33 71 73.02.
-

- .2 Terminate cables in accordance with Section 26 05 20.
- .3 Cable Colour Coding: to Section 26 05 00.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 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.
- .7 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.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 In underground ducts in accordance with Section 26 05 43.01.
 - .3 In surface and lighting fixture raceways in accordance with Section 26 50 00.
 - .4 In wireways and auxiliary gutters in accordance with Section 26 05 31.

3.4 INSTALLATION OF ARMoured CABLES

- .1 Group cables wherever possible on channels.

3.5 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for connectors and terminations.

1.2 RELATED SECTIONS

- .1 Section 26 05 31.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 153, No. 158.
 - .2 CSA C22.2 No.41-07, Grounding and Bonding Equipment.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

Part 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel or short barrel compression connectors, as required by CSA and the required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 2, 3 and 4 way joint boxes, dry location type in accordance with Section 26 05 33.

Part 3 EXECUTION

3.1 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.

END OF SECTION

Part 1 GENERAL

1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.
- .2 Single runs: Galvanized conduit straps or ringbolt type hangers.
- .3 Multiple runs: Conduit rack with 25 per cent spare capacity.
- .4 Vertical runs: Channel support with conduit fittings/clamps.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to hollow masonry, tile and plaster surfaces with lead anchors or nylon shields.
 - .2 Secure equipment to poured concrete with expandable inserts.
 - .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
 - .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
 - .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
 - .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
 - .7 Suspended support systems.
-

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00.

Part 2 PRODUCTS

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.3 CABINETS

- .1 Construction: welded sheet steel hinged door, latch and catch
-

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Submit samples for floor box in accordance with Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
 - .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 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 Single gang device, 102 mm square or octagonal outlet boxes for lighting fixture outlets.
 - .5 Extension and plaster rings for flush mounting devices in finished plaster and tile walls.
-

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Refer to drawings for floor box details and requirements.

2.6 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CAN/CSA-C22.2 NO. 18.1-04, Metallic Outlet Boxes.
 - .3 CAN/CSA-C22.2 NO. 18.2-06, Nonmetallic Outlet Boxes.
 - .4 CAN/CSA-C22.2 No. 18.3-04(R2009), Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B).
 - .5 CSA C22.2 No. 45.1-07, Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007).
 - .6 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .7 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.
 - .8 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
 - .9 CAN/CSA-C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 PRODUCTS

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
-

- .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45. hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .5 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

- .1 One hole malleable iron straps to secure surface conduits 51 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 51 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 27 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid hot dipped galvanized steel threaded conduit.
- .4 Use electrical metallic tubing (EMT) except in cast concrete.
- .5 Use rigid pvc conduit underground areas.
- .6 Use flexible metal conduit for connection to motors or transformers in dry areas.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Minimum conduit size for lighting and power circuits: 21 mm.
- .9 Install EMT conduit from branch circuit panel to outlet boxes.
- .10 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 21 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Run 2-27 mm spare conduits up to ceiling space and 2- 27 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .15 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.8 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-Z809-08, Sustainable Forest Management.
- .2 Insulated Cable Engineers Association, Inc. (ICEA)
- .3 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
- .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 02 42 93.

Part 2 PRODUCTS

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with clear, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
-

- .2 Cedar post type markers: to CAN/CSA-Z809 or FSC or SFI 89 x 89mm, 1.5 m long, pressure treated with clear, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.
 - .1 Nameplate: aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction.

Part 3 EXECUTION

3.1 EXAMINATION

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

3.2 DIRECT BURIAL OF CABLES

- .1 After sand bed in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
 - .1 Do not pull cable into trench.
- .2 Include offsets for thermal action and minor earth movements.
 - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.
 - .1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.
- .4 Underground cable splices not acceptable.
- .5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .6 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

- .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
- .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
- .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.
- .7 After sand protective cover is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks, interlocking cable blocks as indicated to cover length of run.

3.3 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.4 MARKERS

- .1 Mark cable every 150 m along cable runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- .5 Install cedar post type markers.
- .6 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:

- .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
- .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 150% of original factory test voltage in accordance with ICEA recommendations.
 - .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by ICEA for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by ICEA.
 - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 10.
 - .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 10.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 50 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.1-12,Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for photoelectric devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Samples:
 - .1 Submit 1 sample of each component proposed for inclusion into system.
 - .2 Components will be returned for incorporation into work.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect photoelectric devices from nicks, scratches, and blemishes.
 - .3 Protect metal accessories and trim from being bent or damaged.
 - .4 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
- .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 02 42 93.

Part 2 PRODUCTS

2.1 PHOTOELECTRIC LIGHTING CONTROL

- .1 Photoelectric Lighting Controls: to CSA C22.1.
-

- .1 Wall mounting.
- .2 Capable of switching 1800 W of lighting at 120 V.
- .3 Voltage variation: plus or minus 10%.
- .4 Temperature range: minus 40 degrees C to plus 40 degrees C.
- .5 Switching on lights at 200 lx.
- .6 Switching off lights at 600 lx.
- .7 Rated for 5000 operations.
- .8 Options:
 - .1 Fail-safe circuit completed when relay de-energized.
 - .2 Sensitivity adjustment.
- .9 Switching time delay of 30 s.
- .10 Wall mounting bracket.
- .11 Colour coded leads: size 10 AWG, 460 mm long.

2.2 CONTACTOR

- .1 Contactor: to CSA C22.1.
 - .1 Cabinet mounting.
 - .2 Capable of switching multiple lamp circuits with total lighting load of 6000 W.
 - .3 Waterproof enclosure.
 - .4 Manual override.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for lighting control device 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.

3.2 INSTALLATION

- .1 Install photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
-

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 SYSTEM DESCRIPTION

- .1 Low voltage control system designed to provide remote switching of lighting loads by use of:
 - .1 Low voltage momentary contact switches
 - .2 Low voltage relays.
 - .3 Control transformers
 - .4 Low voltage rectifiers
 - .5 Motor switch control.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data in accordance with Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .2 Separate and recycle waste materials in accordance with Section 01 74 20, and with Waste Reduction Workplan.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- .4 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components.

2.2 REMOTE CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, standard duty, rated 3A, 25V, double push-button action with pilot lights.

2.3 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
 - .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
 - .3 Operating voltage: 24V, AC.
 - .4 Load contacts: 20A, 120, 347V, AC.
-

.5 Auxiliary contacts for pilot light.

.6 Coloured pre-stripped leads.

2.4 CONTROL TRANSFORMER

.1 Low voltage power Class 2, input 120 V, AC, 60Hz, output 35 VA at 24V.

2.5 RECTIFIER

.1 Selenium type: 24 V, AC, 60 Hz input, 0.36 A continuous duty output.

.2 Silicon type: 24 V, AC, 60 Hz input, 7.5 A continuous duty output.

2.6 MANUAL CONTROL

.1 individual remote control switches as indicated.

.2 Eight circuit manual master selector switch mounted in 100 mm square box with:

.1 Master lock-out switch

.2 Individual red jewelled pilot lights.

.3 Nine circuit manual dial-type master selector.

.4 Twelve circuit manual dial-type master selector.

2.7 MOTOR OPERATED MASTER CONTROL

.1 Motor-driven multiple contact momentary switching device.

.2 Radial contact arm to rotate through one revolution in 17 s.

.3 Contact made in succession between 25 points around circle.

.4 One master required for "ON" operation and one for "OFF" operation.

.5 Motor master units connected in cascade to control circuits.

.6 Interface equipment as required to convert maintained contact signals to momentary contact control pulses.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00.

.2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00
- .2 Section 26 28 16

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards 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 Province of Ontario, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards 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 02 42 93.
-

- .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 02 42 93.

Part 2 PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 600 V panelboards: bus and breakers rated for 25kA (symmetrical) interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for receptacles, fire alarm, emergency, door supervisory, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
 - .2 Nameplate for each panelboard size 4 engraved as indicated.
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- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards 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.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA-C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
 - .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 02 42 93.
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Part 2 PRODUCTS

2.1 SWITCHES

- .1 15, 20 A, 120 V and 347 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project - Decora type.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project - Decora type .

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
- .2 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and plastic flush type.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches in wet locations.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

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

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

1.2 SUBMITTALS

- .1 Provide submittals in accordance with 01 33 00.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 400A. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 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 20.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Three spare fuses of each type and size installed above 600A.
- .3 Six spare fuses of each type and size installed up to and including 600A.

Part 2 PRODUCTS

2.1 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class L fuses.
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
-

- .2 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
- .3 Class R -R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class C fuses.

2.3 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0mm thick aluminum 750 mm high, 600mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International (CSA)
 - .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).

1.2 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 60A and over 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:
 - .2 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .3 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .4 Contractor's name and address and person responsible for project.
 - .5 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .6 Name and address of building where circuit breakers will be installed:
 - .1 Project title:
 - .2 End user's reference number:
 - .3 List of circuit breakers:

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers indoors 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 and in accordance with Section 02 42 93.
- .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 02 42 93.

Part 2 PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and ground-fault circuit-interrupters and: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 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.
- .6 Circuit breakers with interchangeable trips as indicated.
- .7 Circuit breakers to have minimum 18kA symmetrical rms interrupting capacity rating.

2.2 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.

2.3 OPTIONAL FEATURES

.1 Include if indicated on drawings:

.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.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of 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.

3.2 INSTALLATION

.1 Install circuit breakers as indicated.

3.3 CLEANING

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

.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.

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

END OF SECTION

Part 1 GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, size as indicated.
- .2 Provision for padlocking in off switch position by locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, to Section 26 28 14.
- .5 Fuseholders: relocatable 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.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000(R2005), Controllers, Contactors and Overload Relays Rated 600 V.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.
- .3 Include operating information required for start-up, synchronizing and shut-down of generating units.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors 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 02 42 93.
 - .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 02 42 93.
-

Part 2 PRODUCTS

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Breaker combination contactor as indicated.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA Enclosure unless otherwise indicated.
- .6 Include following options in cover:
 - .1 Red, Green indicating lamp.
 - .2 Stop-Start pushbutton.
 - .3 Hand-Off-Auto selector switch.
- .7 Control transformer: in accordance with Section 26 29 03, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00.
- .2 Size 4 nameplate indicating name of load controlled.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
-

- .2 Repair damage to adjacent materials caused by contactor installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-2004, American National Standard for Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts.
 - .2 ANSI C82.4-2002, American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable, spacing criterion.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.3 QUALITY ASSURANCE

- .1 Provide mock-ups in accordance with Section 01 45 00.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .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 as specified in Construction Waste Management Plan in accordance with Section 02 42 93.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

Part 2 PRODUCTS

2.1 LAMPS

- .1 As indicated on fixture schedule.

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.
 - .1 Rating: voltage as indicated, for use with lamps.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
 - .4 Current crest factor: 1.7maximum.
 - .5 Harmonics: 10 % maximum THD.
 - .6 Operating frequency of electronic ballast: 20kHz minimum.
 - .7 Total circuit power: 62 Watts.
 - .8 Ballast factor: greater than 0.90.
 - .9 Sound rated: Class A.
 - .10 Mounting: integral with luminaire.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.5 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
-

- .2 Provide adequate support to suit ceiling system.
 - .1 Provide drywall trim kits for fixtures to be installed in drywall ceilings.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .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 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
- .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 02 42 93.

1.5 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.
-

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 12V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit, remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: as indicated on fixture schedule.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: White.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Battery disconnect device.
 - .6 AC input and DC output terminal blocks inside cabinet.
 - .7 Cord and plug connection for AC.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: in accordance with Section 26 05 34.
- .2 Conductors: type in accordance with Section 26 05 21, sized in accordance with manufacturer's recommendations.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's 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.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-10, Unit Equipment for Emergency Lighting.
 - .2 CAN/CSA-C860-07, Performance of Internally Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101-2009, Life Safety Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: White die cast aluminum.
- .3 Lamps: 3W LED maximum.
- .4 Operation: designed for 75,000 hours of continuous operation without relamping.
- .5 Pictogram: Green on white. International Running Man
- .6 Downlight: acrylic in bottom of unit.

2.2 DESIGN

- .1 Recessed, wall, end to wall, ceiling mounting.
-

- .2 Single, Double face.
- .3 Arrow: right, left.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

1.2 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

Part 2 PRODUCTS

2.1 GROUNDING BUSBAR

- .1 Predrilled copper busbar, electro tin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI.

2.2 WARNING LABELS

- .1 Non-metallic warning labels in English and French to: ANSI J-STD-607-A.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

Part 3 EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR

- .1 Install grounding bus bar on insulated supports 50 mm high at location close to electrical power panel if one is installed in same room or as indicated.
- .2 Install copper bonding conductor as indicated to alternating current equipment ground.

3.2 BONDING CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing 6 AWG copper conductor.
-

3.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Install bonding conductor for telecommunications from IT Room to service equipment (power) ground.
- .2 Use exothermic welding, approved 2 hole compression lugs 1 hole non-twisting lugs for connection to telecommunications main grounding busbar.

3.4 BONDING

- .1 Bond metallic raceways in telecommunications entrance room using 6 AWG green insulated copper conductor.
- .2 Bond equipment rack cabinet located in telecommunications room using 6 AWG green insulated copper conductor.
- .3 All metallic parts of the cable distribution supporting system shall be bonded together mechanically, including at all transition points using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the telecom room and then bonded to their respective telecom ground bus bars.

3.5 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communication raceway systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .1 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
- .2 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 02 42 93.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2 Conduit distribution system.

2.2 MATERIAL

- .1 Conduits: in accordance with Section 26 05 34.
 - .2 Junction boxes, cabinets type: in accordance with Section 26 05 31.
 - .3 Outlet boxes conduit boxes, size, and fittings: in accordance with Section 26 05 31.
 - .4 Fish wire: polypropylene type.
-

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems 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.

3.2 INSTALLATION

- .1 Install raceway system, including distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214-08, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232-M1988(R2004), Optical Fiber Cables.
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
 - .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
 - .3 TIA/EIA-568-B.3-(2000), Optical Fiber Cabling Components Standard.
 - .4 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
 - .5 TIA TSB-140-2004, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - .6 TIA-598-C-(2005), Optical Fiber Cable Color Coding.

1.2 DEFINITIONS

- .1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 SYSTEM DESCRIPTION

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
 - .1 Horizontal cables link work areas to telecommunications rooms located on same floor.
 - .2 Telecommunications rooms linked to main terminal/equipment room (MT/ER) by backbone cables.
 - .3 MT/ER also linked to Entrance Room by backbone cables.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 As-built Records and Drawings:
 - .1 Provide Microsoft Access database reflecting cable installation and cross-connections.
-

- .2 Provide electronic drawings in AutoCAD 2011 format depicting all construction.
- .3 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.
 - .1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 FOUR-PAIR 100 BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 or to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-B.2.

2.2 MULTI-PAIR 100 BALANCED TWISTED PAIR CABLE

- .1 100 ohm, 100 pairs, sheath consists of thermoplastic jacket with underlying metallic shield, Category 3 to: TIA/EIA-568-B.2, flame test classification to: CSA-C22.2 No. 214.

2.3 WORK AREA UTP 2-PAIR.4 MODULAR JACK

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568- B.2:
 - .1 In self-contained surface-mount box, 4 jacks per box.
 - .2 Mounted in compatible single gang faceplate, flush entry, 4 jack positions per faceplate.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 IDC Terminal strips, 25 pair, for terminating multi pair 100 balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6 to: TIA/EIA-568-B.2.
- .2 Mount or block for housing 10 IDC terminal strips, mounted on wall, rack or cabinet as indicated.
 - .1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.
- .3 Patch panel, 2 rack units high, 48 ports:
 - .1 Each port equipped with factory installed "RJ-45" modular type jacks, type T568A Category 6 to: TIA/EIA-568-B.2.
 - .2 Horizontal cable-management unit for every 48 ports.

- .3 Consolidation point, terminates 12 UTP horizontal cables from telecommunications room on IDC terminations. Cables extending to work areas terminate on IDC terminal strips RJ-45 jacks, type T568A. Category 6 to: TIA/EIA-568-B.2.

2.5 UTP CROSS-CONNECT WIRE

- .1 Category 6, 4 pairs to: TIA/EIA-568-B.2.

2.6 UTP PATCH CORDS

- .1 2.0 meters long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-B.2.

2.7 UTP EQUIPMENT CABLE

- .1 4 pair "cable", 2.0 meters long, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack: Category 6 to: TIA/EIA-568-B.2.

2.8 UTP WORK AREA CORDS

- .1 3.0 meters long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568-B.2

2.9 OPTICAL-FIBER CABLE

- .1 Distribution, with conductive members, multi-mode 50/125, laser-optimized, 2000 MHz km capacity strands to: CSA-C22.2 No. 232 and TIA/EIA-568-B.3, flame test classification FT4, each end terminated with duplex LC connectors.

2.10 OPTICAL-FIBER PATCH PANEL

- .1 Mounted in rack or cabinet, 1 rack unit, with lockable cover, capable of terminating sufficient fiber, equipped with duplex LC compatible adapters.

2.11 OPTICAL-FIBER PATCH CORDS

- .1 Interconnect cable, 2 strands, 2 meters long, each end equipped with duplex LC connectors. Multi-Mode 62.5/125 micron to: TIA/EIA-568-B.3.

Part 3 EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.
- .2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables in conduits from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A. The cable length from telecommunication room to the workstation location shall not exceed 90 meters.
- .2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .3 Coil spare cables and store in ceiling space in zone.
- .4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 INSTALLATION OF BACKBONE CABLES

- .1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 INSTALLATION OF EQUIPMENT CABLES

- .1 Install equipment cables from equipment patch panel as indicated.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.

3.5 IMPLEMENT CROSS-CONNECTIONS

- .1 Implement cross-connections using patch cords as specified.

3.6 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy, and electronic record on CD.
 - .1 Perform tests for Permanent Link on installed cables, including spares:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
 - .2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
 - .2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy, and electronic record on CD.
 - .1 Perform tests for Permanent Link on 4-pair cables:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
 - .2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.
 - .3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B.1 and correct deficiencies: provide record of results as hard copy and electronic record on CD.
 - .1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.
 - .1 Attenuation to be less than 2.0 dB, unless consolidation point is used.

- .2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.
- .2 Test backbone links in one direction. Backbone links:
 - .1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).
 - .2 Test single-mode fiber at both applicable wavelengths (1550 nm and 1310 m).
- .3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.
 - .1 Multi-mode-fiber attenuation coefficients:
 - .1 3.5 db/km @ 850 nm; and
 - .2 1.5 db km @ 1300 nm
 - .2 Single-mode fiber attenuation coefficients at both 1310 nm and 1550 nm:
 - .3 1.0 db/km for inside plant cable; and
 - .4 0.5 db/km for outside plant cables.
 - .3 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.
- .4 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on horizontal backbone fiber pairs to: TSB-140.
 - .1 Correct deficiencies.
 - .2 Provide record of results as described in SUBMITTALS.
- .5 Provide record of results as hard copy and electronic record on CD to: TIA/TSB-140.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Industry Canada - Terminal Attachment Program
 - .1 CS-03-2010, Compliance Specification.
- .2 Correctional Service Canada (CSC):
 - .1 ES/SPEC-0101, Public Address system for use in Federal Correctional Institutions
 - .2 ES/SPEC-0402, PIDS Public Address System for use in Federal Correctional Institutions
 - .3 ES/SOW-0110, Structured Cable Systems for Electronic Security Installation.
 - .4 ES/SOW-0101, Statement of Work for Electronic Systems for Correctional Services of Canada Institutions.

1.2 DEFINITIONS

- .1 PIDS Perimeter Intrusion Detection System
- .2 PA Public Address

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for public address and mass notification systems 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 Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Riser diagram, block diagram of complete public address system.
 - .2 Public address system design criteria.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for public address system for incorporation into manual.
 - .3 Include in manual:
 - .1 Operation instructions.
 - .2 Description of system operation.
 - .3 Description of each subsystem operation.
 - .4 Wiring Diagram to detail where module connections terminate and how wires are routed and terminated.
-

- .5 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
- .6 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect public address 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 and in accordance with Section 02 42 93.
- .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 02 42 93.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 The system shall be of a modular design and it shall be possible of a future date to add more control stations and associated speaker equipment to the basic installed complement without requiring the existing hardware.
- .2 System and all associated equipment shall be rated for and capable of 24 hours per day, seven days per week operation.

2.2 PA SYSTEM CONFIGURATION

- .1 The PA system shall be functionally divided into a number of zones and sub-zones covering designated sections of the institution. The PA system consists of the following elements:
 - .1 One or more Master Control Stations, each consisting of a master control panel and a microphone or an institution telephone set.;
 - .2 One or more Secondary Control Stations, each consisting of a secondary control panel and a microphone or an institution telephone set;
 - .3 One or more loudspeaker assemblies, each consisting of a loudspeaker and matching transformer, an enclosure and a baffle plate or horn;
 - .4 Common equipment (amplifiers, power supplies, switches, etc.);
 - .5 Interconnecting wiring, cables, etc.;
 - .6 Conduit, ducts, outlet boxes, etc.;

- .7 Grounding conductor for system components.
- .2 System shall be a constant-voltage type having tap selectable speaker transformers to permit the proper audio power output from each speaker.

2.3 PIDS PA SYSTEM CONFIGURATION

The PIDS PA system elements shall be deployed zone by zone at the perimeter of the institution corresponding to the alarm and detection zones of the PIDS system. The PIDS PA system shall consist of the following elements in quantities to be determined by the contractor as required to support this requirements.

- .1 PIDS PA Switcher consisting of:
 - .1 A zone selector switch
 - .2 A microphone; and
 - .3 Test tone generator
- .2 Loudspeaker assemblies, one or more per zone, consisting of:
 - .1 Loudspeaker and matching transformer;
 - .2 Horn; and
 - .3 Mounting fixture.
- .3 Common equipment (amplifier, power supply, etc.)
- .4 Interconnecting wire, cable, conduits, ducts, junction boxes, etc.
- .5 Interface to data logger: supply and install all necessary wiring and control equipment required to interface the system to the PIU Data Logger.

2.4 MATERIALS

- .1 Conduits: in accordance with Section 26 05 34.
- .2 Communication conductors: as required by Manufacturer.

2.5 WIRING SUPERVISION

- .1 Wiring shall be supervised in all PA system modes. An alarm shall occur if any system wiring is cut or shorten to other wires or if the system devices are tampered with by unauthorized people or environmental conditions.

2.6 SABOTAGE, TAMPERING AND SURVIVABILITY

- .1 Elements of the system must operate in areas exposed to inmate access and shall have high resistance to damage, destruction, or conversion to other uses (including weapons). All interconnecting service must be secure against tampering or improper interference.

2.7 PA SYSTEM OPERATIONAL REQUIREMENTS

- .1 General:
-

- .2 The PA system shall provide satisfactory sound distribution within each designated area of the institution. The equipment shall produce high speech intelligibility throughout the area covered by the system at all normal microphone distances and shall be entirely free of audible transients as circuits are selected and de-selected and microphones are switched. The microphone input circuit shall employ automatic level control with a minimum of 40 dB limiting range. The control stations shall be capable of selecting any number of zones simultaneously by actuating the desired zone-select switch.
- .3 Secondary Control Station shall be able to make a PA announcement to a particular sub-zone or zone by:
- .1 Momentarily depressing the associated push-button selector switch on the secondary control panel causing it to become illuminated steady ON, then
- .2 Depressing the microphone Push-to-Talk (PTT) switch to activate the voice circuit
- Releasing the PTT switch will remove the microphone from the voice circuit but will leave the zone/sub-zone selector actuated and the push-button illuminated.
- Where a sub-zone consists of more than one speaker assembly, all shall be selected by a single push-button selector.
- When the announcement is complete, momentarily depressing the push-button selector causing the illuminated push-button to extinguish and the associated voice circuit to be released.
- Other secondary annunciation panels shall not receive the audio message from the first panel.
- .4 Master control Station shall be able to make PA announcements into any of the zones, but not address a specific sub-zone. The method of performing this is identical to that described above for the secondary control panel. The master control panel shall have the capability to override an announcement in progress originating from any secondary panel. When this occurs, the priority message shall be heard on the monitor speaker at the secondary station and the voice message from secondary station shall be cut off.

2.8 PIDS PA SYSTEM FUNCTIONAL REQUIREMENTS

- .1 The Perimeter Intrusion Detection system Integration Unit shall control the PIDS PA system. In the event of a perimeter alarm conditions, the output of the PIDS PA shall be automatically switched to the perimeter sector being assessed by CCTV system. The output of the PA system shall be switched on a sector by sector basis under alarm conditions. The PIDS PA shall provide the MCCP operator one way voice communication to an alarmed sector. The activation of the PA shall be under the control of the operator using the push-to-talk switch on the microphone. Only the activation and actual use of the PIDS PA shall be logged by the PIU data logger.

2.9 ENVIRONMENTAL REQUIREMENTS

- .1 The PA system shall operate over the following indoor environmental conditions:
- .1 Temperature: 0° C to +50° C;
- .2 Humidity: 0 to 90% relative, non-condensing; and
- .3 Location: sheltered environment
- .2 The PA system shall operate over the following outdoor environmental conditions:

- .1 Temperature: -40° C to +55° C;
- .2 Humidity: up to 100% relative, condensing; and
- .3 Location: extremes of wind, driving rain, ice loading, blown sand and dust, sun exposure.

2.10 POWER REQUIREMENTS

- .1 The PA system shall use VAC power within the following limits:
 - .1 Voltage: 120VAC ±10%;
 - .2 Frequency: 60Hz ± 1.5%;
 - .3 Transients: up to 5 times nominal voltage for up to 100 msec durations. Changes in the input power or any fluctuations within the above limits shall not cause damage to the unit; and
 - .4 Power: power consumptions shall not exceed 100 watts.

2.11 INTERFERENCE

- .1 Performance of the system shall not be affected by the use of standard electronic equipment used at the institution.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for public address systems 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.

3.2 INSTALLATION

- .1 Install equipment in accordance with manufacturer's instructions, and as indicated.
- .2 PIDS PA Speakers shall be installed outdoors and shall be rugged, weatherproof units capable of satisfactory operation under the environmental conditions of this specification. The speaker units and their mountings shall exhibit high resistance to damage or destruction due to deliberate, physical abuse. Speakers shall be mounted so as to be unreachable without climbing aids such as ladders, etc. Speakers shall be mounted on the outside of the inner perimeter fence.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
 - .2 Conduct intelligibility test.
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3.4 CLOSEOUT ACTIVITIES

- .1 Manufacturer's factory service engineer to instruct:
 - .1 Maintenance personnel in maintenance of system.
 - .2 Operating personnel in use of system.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by public address and mass notification systems installation.

END OF SECTION

Part 1 GENERAL

1.1 PURPOSE

- .1 To verify that installations are in accordance with project requirements.
- .2 To ensure proper system operation.

1.2 COMMISSIONING ORGANIZATIONS

- .1 Certified member of ECAO or CFAA.

1.3 RELATED SECTIONS

- .1 Section 01 91 00 - Commissioning.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 PROCEDURES

- .1 Follow manufacturer's recommendations for testing.
 - .2 Inspect wiring connections to all devices comprising the system.
 - .3 Verify supervision of wiring at every device connection to a supervised circuit.
 - .4 Test operation of every device on a system to verify its function.
 - .5 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.
 - .6 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.
 - .7 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.
 - .8 Test automatic devices by simulating an operating condition.
 - .9 Wiring:
 - .1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:
 - .1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;
 - .2 Terminations of conductors entering and leaving equipment have been made;
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- .3 Circuit polarities are in accordance with the system design, where applicable.
 - .2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.
 - .10 Initiating Devices - Manual:
 - .1 Inspect manual alarm stations in consideration of the following:
 - .1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;
 - .2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.
 - .11 Automatic heat detectors:
 - .1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.
 - .2 Test equipment - Heat lamp or Air heater. **DO NOT USE AN OPEN FLAME HEAT SOURCE.**
 - .3 Apply heat source as to not damage or operate fusible disc parts.
 - .12 Automatic heat detectors - non-resettable:
 - .1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.
 - .13 Automatic smoke detectors - area type:
 - .1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.
 - .14 Automatic smoke detectors:
 - .1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.
 - .2 Test gas to be used similar to Automatic Smoke Detector.
 - .15 Alarm signals - audible:
 - .1 Test on main power supply and standby power supply with the maximum expected load on the system.
 - .2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.
 - .3 Decibel recordings in each are covering 100 sq. metres shall be taken.
 - .4 The level of sound should usually be 15 db above ambient noise level.
 - .16 Alarm signals - visual:
 - .1 The visual signal appliances shall function as intended and shall be clearly visible.
 - .17 Annunciators, printers and workstations:
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- .1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:
 - .1 The zone of each alarm initiating device is properly indicated;
 - .2 The legend is clearly visible;
 - .3 Adequate voltage under local conditions is present;
 - .4 Wiring connections have been made in a workmanlike manner.
 - .5 Proper care must be taken to establish that each item is complete and satisfactory.
 - .18 Standby power supplies - batteries:
 - .1 Examine batteries for possible damage and consideration of the following:
 - .1 The charging system functions as intended;
 - .2 The installation has not resulted in the bypassing of a fuse or a similar protective device;
 - .3 The installation protects the batteries from accidental or mechanical damage.
 - .4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.
 - .19 Control equipment and transponders:
 - .1 Test to establish that they function as intended. The following examinations and tests shall be performed:
 - .1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;
 - .2 Verification that all field wiring is terminated in a workman-like manner;
 - .3 All lamps and indicators shall be tested for operation and intended function;
 - .4 All keypad functions shall be tested for operation and intended function;
 - .5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;
 - .6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;
 - .2 Commissioning Report:
 - .1 Provide in accordance with requirements of Section 01 91 00, supplemented as specified herein.
 - .2 Report to include relevant information of the system including:
 - .3 Each system part described.
 - .4 How the system is operated.
 - .5 What functions the system performs.
 - .6 Requirements for tests and service.
 - .7 Itemization of all devices connected on the system, their general location.
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- .8 The date of the performed tests.
- .9 All pertinent details of the report sheets requested.
- .3 Verification:
 - .1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Abbreviations:
 - .1 Electronic Access Control (EAC): control of people through entrances and exits of controlled area. Security utilizing hardware systems and specialized procedures to control and monitor movements within a controlled area.
 - .2 CPVX: Central Station Burglar Alarm Systems.
 - .3 CVSG: Mercantile Burglar Alarm Systems.
 - .4 CVWX: Proprietary Burglar Alarm Systems.
 - .5 DRS: Door Release System.
 - .6 PIN: Personal Identification Number.
- .2 Reference Standards:
 - .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Underwriters' Laboratories (UL)
 - .1 UL 294-2009, Access Control System Units.
 - .2 UL 603-08, Power Supplies for Use with Burglar Alarm Systems.
 - .3 UL 827-2008, Central-Station Alarm Services.
 - .3 National Fire Protection Association (NFPA)
 - .1 NFPA 70-2011, Article 517, National Electric Code.
 - .2 NFPA 101-2012, Life Safety Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for access controls and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
 - .3 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

- .2 Shop drawings to indicate project layout, including details.
 - .1 Shop drawings to indicate, mounting heights and locations, wiring diagrams.
 - .2 Submit zone layout drawing indicating number and location of zones and areas covered.
 - .3 Submit wiring diagrams.
 - .4 Submit complete equipment list.
- .4 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 1 sample of each component proposed for inclusion into system. Components will be returned for incorporation into work.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit ULC/UL Product Safety Certificates.
 - .2 Submit verification Certificate that service company is ULC/UL List alarm service company.
 - .3 Submit verification Certificate that monitoring facility is ULC/UL "Listed central station".
 - .4 Submit verification Certificate that security access system is "Certified alarm system".
- .6 Test and Evaluation Reports:
 - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .8 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for access controls and equipment for incorporation into manual.
 - .1 Include:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.
 - .6 Cleaning instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect access controls and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 02 42 93.
- .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 02 42 93.

1.5 WARRANTY

- .1 Manufacturer's Warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Design Criteria:
 - .1 Design access control and security access systems using only ULC/UL listed products.
 - .2 Design security access system using ULC/UL listed alarm service company, company specializing in security access systems.
 - .3 Design security access system for ULC/UL listed central station an alarm monitoring facility having capability to provide specified service.
 - .4 Design security access system as a ULC/UL certified alarm system
 - .5 Design system as type: central.
 - .6 Design access control systems to meet safety requirements to UL 294.
 - .7 Design system to provide door manual and automatic control functions from locations indicated to central monitoring system.
 - .8 Design system to allow for addition of future Door Release System (DRS) controls and activation units by adding appropriate transmission lines and equipment at each location.
 - .9 Design system to consist of homed run control to activation unit connections.
 - .10 Each activation unit must have door panel control function/equipment item located as indicated.
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- .11 Design system to provide ease of operation, servicing, maintenance, testing and expansion of additional services.
 - .12 Door activation units:
 - .1 Fully complement and function and match door manufacturer's magnetic controls and hardware.
 - .2 Fully function with OEM supplied door controls and hardware to activate system in routine and emergency conditions.
 - .3 Fully function within supplied electrical supervision circuits as specified.
 - .13 Control Panel:
 - .1 Fully compatible, compliment and operate door magnets provided by door manufacturer of system or OEM supplied door operating hardware.
 - .2 Complete with push button or electronic key pad to release and secure each door.
 - .3 Identify each door control function with lamp electronically identified on panel or associated display unit.
 - .4 Permanently label (paper labels are not acceptable) or electronically identified each door location on panel or associated display unit.
 - .5 Fully function within supplied electrical supervision circuits as specified.
 - .14 Control Signal Standards:
 - .1 Input and Output Signal: 0.0 dBmV + 1.0 dBmV Level.
 - .2 Input and Output Signals: terminated on each control unit.
 - .3 Input and Output Impedance: 120 Ohms, BAL.
 - .4 Channel Bandwidth:
 - .1 Data: 300 Hz to 3.5 kHz (9.6 kilo bits per second rate).
 - .2 DC: 0.5 Hz to 100 Hz, + 5.0%, MIN.
 - .5 S/N Ratio: 60 dBmV + 1.0 dBmV.
 - .15 Intercom System:
 - .1 Design door answering system with door and interior stations including door release where indicated.
 - .2 System to be complete with system calls, audio and video, and mounting requirements as specified.
 - .2 Door controls items and panels:
 - .1 Include standard "off the shelf" equipment items to form a complete and operating DRS system.
 - .2 Include: equipment cabinets, equipment panels, AC power strips, power line conditioner, system power supply, junction box, door control panels, door activation units, electronic supervising master panel, electronic supervising remote panels, system connectors, and system cables.
 - .3 Provide system cables including coaxial cable, multiconductor control cable, audio and AC power cable required.
 - .4 Number of stations: 1; audio only; selectable call; door release; vandal proof.
 - .5 Power supplies: to UL 603.
-

- .6 Connectors and switches: to ULC-C634.
 - .7 Intercom:
 - .1 Door stations: durable construction, to suit application, surface mount, colour white.
 - .2 Interior stations: durable construction, to suit application, surface mount colour white.
 - .3 Audio and video.
 - .4 Video: Black and white.
 - .5 Call type: selective call with privacy handsets.
 - .8 Basic System Criteria:
 - .1 Card readers:
 - .1 Type:proximity.
 - .2 Proximity technology.
 - .3 Fitted with LED indicator light.
 - .4 Reading distance 50 - 200 mm.
 - .5 Compatible with HID access card
 - .2 Cards: provided by owner
 - .3 Number of access levels (assigned to cardholders): 3 minimum.
 - .4 Schedules:
 - .1 Number of date schedules required: 100.
 - .2 Number of holiday schedules required: 180.
 - .3 Allow full schedule description label of 30 alphanumeric characters.
 - .4 Include 4 time intervals/day.
 - .5 Groups:
 - .1 Design system to include possibility of group association in following categories:
 - .1 Controller groups : 100.
 - .2 Door groups: 100.
 - .3 Relay groups: 100.
 - .4 Input groups: 100.
 - .5 Access groups: 100.
 - .2 Design groups with fully customizable field of 30 alphanumeric characters for easy renaming of associated group.
 - .6 Operating system: Windows NT.
 - .7 Connection: local.
 - .8 Language: English
 - .9 Off site monitoring of alarm conditions.
 - .9 System Accessories:
 - .1 Door strike: latch, UL approved complete with mounting hardware.
 - .2 Request to exit motion detector device:
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- .1 Infrared detection.
- .2 Continuous low-voltage operation.
- .3 Fitted with indicator light.
- .4 Integrated with local audio alarm (electronic buzzer).
- .5 Adjustable coverage.
- .3 Request to exit push button device:
 - .1 Heavy duty assembly.
 - .2 Size: square, 50 x 50 mm.
 - .3 Sturdy and attractive finishing plate with security screws.
- .4 Pull station power interrupt.
- .5 Power supplies:
 - .1 Continuous low-voltage operation output.
 - .2 Equipped with secondary protection for each output.
 - .3 Individual outputs for connection of devices.
 - .4 AC power failure output.
 - .5 DC power failure output and low battery output.
 - .6 Fitted with tamper contact.
 - .7 Wall mounted cabinet with locked door complete with 2 keys.
- .6 Voltage: 12 volt DC.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access control system 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.

3.2 INSTALLATION: SECURITY ACCESS

- .1 Install security access systems and components in accordance with UL 681, UL 1641.
- .2 Install components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .3 Install components secure to walls, ceilings or other substrates.
- .4 Install required boxes in inconspicuous accessible locations.
- .5 Conceal conduit and wiring.

3.3 SITE TEST AND INSPECTION

-
- .1 Perform verification inspections and test in presence of Departmental Representative.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors, manufacturer's representatives and security specialists are present for verification.
 - .2 Pretesting procedure:
 - .1 Verify (utilizing an approved spectrum analyzer and test equipment) that system is fully operational and meets all system performance requirements of this specification.
 - .2 Measure and record, control (and/or voice) carrier levels of every system channel at each of following points in the system:
 - .1 Door located actuating devices.
 - .2 Door control panel functions.
 - .3 Electronic supervisory control units inputs and outputs.
 - .4 Distribution system input and output.
 - .5 Telephone system interface input and output.
 - .3 Submit to Departmental Representative 2 copies of recorded system pretest measurements, along with pretest certification.
 - .3 Performance testing:
 - .1 Test procedure: perform test on a "go-no-go" basis.
 - .1 Make only operator adjustments required to show proof of performance.
 - .2 Test to demonstrate and verify that installed system complies with installation and technical requirements of this specification under operating conditions.
 - .3 Test results to be evaluated by Departmental Representative as either acceptable or unacceptable using following procedures.
 - .2 Documentation review:
 - .1 This review will determine if information provided is sufficient to meet requirements of this specification.
 - .2 Provide for review all System manuals, as installed drawings, pretest form, antenna radiation pattern, equipment cabinet pictorial, antenna pictorial, antenna mount pictorial, video and audio equipment details.
 - .3 Mechanical inspection:
 - .1 Departmental Representative and Contractor to tour areas to insure that Systems and Subsystems are installed in place for proof of performance testing.
 - .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
 - .1 Electrical power circuits designated for system equipment are properly labeled, wired, phased, protected and grounded.
 - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
 - .3 Dust, debris, solder splatter, etc. are cleaned and removed from site.
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- .4 Equipment is properly labelled.
 - .5 Equipment identified in system's equipment lists are in-place and properly installed.
 - .6 Each lightning and System ground method are installed in accordance with manufacturer's instructions and this specification.
- .4 Subsystem functional test:
- .1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.
 - .1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.
 - .2 Control units:
 - .1 Take S/N readings from control unit's input and output in manual (and/or automatic) mode. Check output of DC/Data converter for S/N. Evaluate entire signal quality at baseband connector output of control unit and remote equipment.
 - .3 Audio:
 - .1 Take S/N readings from transmitter input and receiver output with equipment placed in manual gain mode. Check output of the audio converter, modulator or demodulator for S/N. Evaluate entire audio signal at baseband connector input and output of control unit.
 - .4 Distribution (or interface) system:
 - .1 Check each door utilizing a volt/ohm (or signal level) meter to confirm each function and to insure that system meets all performance requirements.
 - .2 Test each interconnection point (i.e.: door unit, junction box "cross connection", control unit, etc.) to ensure compliance with this specification.
 - .5 Total system test:
 - .1 Proceed with testing when system and subsystems are functionally tested and accepted. Total system tests to verify that requirements have been met for DC (and/or audio), sub carrier, and control signals in accordance with this specification.
 - .6 Safety:
 - .1 Demonstrate with documentation that access control system meets safety requirements specified in UL 294.
- .5 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
- .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
-

- .6 Device and cabling identification.
- .7 Application and location of ULC approval decals.
- .6 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Validate sensitivity of readers and applicability and application of cards.
 - .2 Connecting joints and equipment fastening.
 - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .7 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer Services:
 - .1 Manufacturer of products, supplied under this Section, to 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:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
 - .2 Submit 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 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
 - .1 Remove protective coverings from accessories and components.

- .2 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.
- .3 Clean components free from dirt and fingerprints.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 02 42 93.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCE DOCUMENTS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 70-2011, Article 517, National Electric Code.
 - .2 NFPA 101-2009, Life Safety Code.
- .2 Correctional Service Canada (CSC):
 - .1 ES/SPEC-0405, Fence Disturbance Detection system for use in Federal Correctional Institutions
 - .2 ES/SOW-0101, Statement of Work for Electronic Systems for Correctional Services of Canada Institutions.

1.2 REFERENCE STANDARDS

- .1 Underwriters Laboratories of Canada (ULC):
 - .2 CAN/ULC-S302-M91(R1999), Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults.
 - .3 CAN/ULC-S303-M91(R1999), Local Burglar Alarm Units and Systems.
 - .4 CAN/ULC-S304-06, Intrusion Detection.
 - .5 CAN/ULC-S306-03, Intrusion Detection Units.
 - .6 ULC-S318-96, Power Supplies for Burglar Alarm Systems.
 - .7 ULC-ORD-C634-M1986, Guide for the Investigation of connectors and Switches for Use with Burglar Alarm Systems.
- .2 Underwriters' Laboratories (UL):
 - .1 UL 603 Amendment 1 - 1999, Standard for Power Supplies For Use With Burglar-Alarm Systems.
 - .2 UL 639- Revision September 30, 2002, The Standard for Intrusion-Detection Units.

1.3 DEFINITIONS

- .1 LTU: Large Transponder Unit.
- .2 FDS: Fence Disturbance Detection System

1.4 SYSTEM DESCRIPTION

- .1 The primary use of the FDS is to provide an intrusion detection capability at the perimeter fences. The FDS and all associated equipment shall be rated for and capable of 24 hours per day, seven days per week operation. Components of the system located outdoors shall be designed to operate continuously over the range of temperature, wind, precipitation and humidity conditions expected on the site and as noted in this specification.
 - .2 The system shall be of a modular design and it shall be possible at a future date to add more sectors or zones and associated processing and control equipment to the basic installed complement without replacing existing hardware.
-

1.5 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00.
 - .1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00.
 - .2 Submit manufacture's literature for each control panel, detection accessory devices.
 - .3 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
- .2 Shop Drawings: Submit in accordance with Section 01 33 00.
 - .1 Submit shop drawings to indicate project layout, mounting heights and locations, wiring diagrams, detection device coverage patterns, contact operating gaps.
- .3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00.
 - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Submit UL Product Safety Certificates.
 - .4 Submit verification Certificate that service company is ULC/UL List alarm service company.
 - .5 Instructions: Submit manufacturer's installation instructions.
 - .6 Manufacturer's Field Services: Submit copies of manufacturer's field reports.
- .4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00.
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.
 - .6 Cleaning instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Deposit packaging materials in appropriate container on site for recycling or reuse.
 - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
 - .3 Collect and separate plastic, paper packaging and corrugated cardboard.
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- .4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin.

1.7 SUPPORT SERVICES

- .1 Provide manufacturer/dealer advice, information and support services for 1 year.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Manufactured by: Manufacturer Senstar 119 John Cavanaugh Drive Carp, ON K0A 1L0 Tel: 613-839-5572 Contact: Tom Coxford.

2.2 WIRING SUPERVISION

- .1 Wiring shall be supervised in all system modes. An alarm shall occur if any system wiring is cut or shortened to other wires or if the system devices are tampered with by unauthorized people or environmental conditions.

2.3 SABOTAGE, TAMPERING AND SURVIVABILITY

- .1 Elements of the FDS shall have high resistance to damage and destruction. All interconnecting service must be secure against tampering or improper interference

2.4 POWER/DATA REDUNDANCY

- .1 The FDS shall be powered from two independent DC power supplies connected to the system at two distinct points. Failure of a single supply shall not cause the system to fail, i.e. either power supply can power the entire system.
- .2 The FDS shall communicate with the system controller at two distinct points. Failure of one data line will not cause the system to fail, i.e. the communications shall be fully redundant.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Sensor cables for the FDS shall be mounted at the inner perimeter fence. All cable runs from the top of the fence to sensor pull boxes, etc. shall be carried in a steel conduit and buried where it leaves the fence. All cable runs from the perimeter to the equipment room and/or MCCP shall be carried in buried conduits. All conduits are to be rigid; rigid steel above ground, rigid PVC below ground.
 - .2 If power is required on the perimeter for the FDS, the power cables shall be buried or run in rigid steel conduit along the outer perimeter fence.
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- .3 Install components and make interconnections as required. Install LTU, UPS, transmitter adjacent to each other in the same cabinet. Make all interconnections.
- .4 Senstar is to supply and install the Large Transponder Unit and make all interconnections to the existing Senstar network. Senstar Stellar are to provide all reprogramming of the FAAS to accomodate the new input point alarms.
- .5 The existing Facility Alarm and Annunciation System in existing main building is to reprogrammed to annunciated operation of the Door Control Kill Switch, PA failure, UPS loss of power, UPS Failure, and UPS Low Battery. Failure of the communications data link is to be alarmed on the Facility Alarm and Annunciation System.
- .6 The interconnection of the new LTU to the existing Senstar Network is to be via RS485 cables.
- .7 Contractor shall be responsible for:
 - .1 Pulling of all cables.
 - .2 Terminating of all cables.
 - .3 Installing all connectors on cables and wiring.
 - .4 Putting all connectors in place on equipment.
 - .5 Testing all cables and wiring.
 - .6 Labelling and indentifying all cables, wiring and terminal strips.
 - .7 Preparing wiring diagrams.

3.3 FIELD QUALITY CONTROL

- .1 Test system for operation. Provide certification from Senstar confirming the system meets the requirements and is functioning properly.
- .2 Manufacturer's 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:
 - .4 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.
 - .5 Twice during progress of Work at 50% and 75% complete.
 - .6 Upon completion of the Work, after cleaning is carried out.
 - .7 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.4 VERIFICATION

- .1 Perform verification inspections and test in the presence of Departmental Representative.
-

- .1 Provide all necessary tools, ladders and equipment.
- .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
- .2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
 - .6 Device and cabling identification.
 - .7 Application and location of ULC approval decals.
- .3 Technical verification: Purpose to ensure that all systems and devices are properly install and free of defects and damage. Technical verification includes:
 - .1 Measurements of coverage patterns.
 - .2 Connecting joints and equipment fastening.
 - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.

3.5 CLEANING AND ADJUSTING

- .1 Remove protective coverings from control panels, detection accessories and components.
- .2 Adjust all components for correct function.
- .3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Video cameras.
- .2 Video handling.
- .3 Recording devices.
- .4 Viewing Station.
- .5 Structured cables.

1.2 REFERENCE DOCUMENTS

- .1 National Fire Protection Association (NFPA):
 - .1 NFPA 70-2011, Article 517, National Fire Code.
 - .2 NFPA 101-2009, Life Safety Code.
- .2 Electronic Industries Association (EIA):
 - .1 REC 12749, Power Supplies.
 - .2 RS 16051, Sound Systems.
- .3 Correctional Service Canada (CSC):
 - .1 ES/STD-0227, LCD Colour Computer Monitor Closed Circuit Television.
 - .2 ES/STD-0228, Network Video User Station Closed Circuit Television.
 - .3 ES/STD-0229, Network Video Recorder Closed Circuit Television.
 - .4 ES/STD-0232, Outdoor Network Colour Dome Closed Circuit Television Camera.
 - .5 ES/STD-0235, Indoor Network Colour Panoramic Closed Circuit Television Camera.
 - .6 ES/SOW-0110, Structured Cable Systems for Electronic Security Installation.
 - .7 ES/SPEC-0409, Perimeter Intrusion Detection Systems Closed Circuit Television System for use in Federal Correctional Institution.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International):
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1 (22nd edition) Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No.1-M87(R1997), Overhead Systems.
 - .2 National Fire Protection Association (NFPA):
 - .1 NFPA 70-2011, National Fire Code.
 - .3 Underwriters' Laboratories (UL):
 - .1 UL 294-1999, Standard for Safety for Access Control System Units.
 - .2 UL 1076-1995, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
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- .4 Underwriters Laboratories of Canada (ULC):
 - .1 ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.4 DEFINITIONS

- .1 CCTV Closed Circuit Television.
 - .2 CCVC Closed Circuit Video.
 - .3 CCD Charge Coupled Device.
 - .4 FOV Field of View.
 - .5 COTS Commercial-Off-The-Shelf.
 - .6 CSA Canadian Standards Association.
 - .7 CSC Correctional Service Canada.
 - .8 DES Director Engineering Services.
 - .9 EIA Electronic Industries Association.
 - .10 FAAS Facility Alarm Annunciation System.
 - .11 FDS Fence Disturbance Detection System.
 - .12 GFE Government Furnished Equipment.
 - .13 MCCP Main Communications and Control Post.
 - .14 MDS Motion Detection System.
 - .15 PA Public Address.
 - .16 PIDS Perimeter Intrusion Detection System.
 - .17 PIU PIDS Integration Unit.
 - .18 RFP Request for Proposal.
 - .19 SIDS Supplementary Intrusion Detection System.
 - .20 SOW Statement of Work.
 - .21 STR Statement of Technical Requirements.
 - .22 UPS Uninterruptable Power Supply.
 - .23 VDU Video Display Unit.
 - .24 CER Common Equipment Room.
 - .25 CET Certified Electronic Technologist.
 - .26 CSV Certified System Vendor.
 - .27 DVO Data/Voice Outlet.
 - .28 EIA Electronic Industries Association.
 - .29 EMT Electrical Metallic Tubing.
 - .30 LOF Laser Optimized Fiber.
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- .31 IDF Intermediate Distribution Frame.
- .32 OTDR Optical Time Domain Reflectometer.
- .33 RCDD Registered Communications Distribution Designer.
- .34 TC Telecomm Closet.
- .35 TIA Telecommunications Industry Association.
- .36 UTP Unshielded Twisted Pair.

1.5 DESIGN PERFORMANCE REQUIREMENTS

- .1 Support: Camera functions such as pan/tilt and zoom fully supported by CCTV system.
- .2 Provide operator with ability to control all camera functions.
- .2 Alarm point monitoring: System capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.
- .3 Switching:
 - .1 Provision to switch any camera in system to any monitor in system manually or automatically.
 - .2 Provision to switch system video recorders to selective monitor outputs in system.
- .4 Control: Provision for any camera equipped with pan, tilt, and/or motorized zoom lens:
 - .1 Manually control pan, tilt and lens functions.
 - .2 Set pan and tilt home position.
 - .3 Set and clear movement limits of pan and tilt mechanism.
 - .4 Adjust motorized zoom lens.
- .5 Enter and edit CCTV programs and save them for future use.
- .6 Set dwell time for viewing of any camera picture.
- .7 Define sequence for viewing cameras on each monitor.
- .8 Bypass cameras in system during sequencing to monitor.
- .9 Provide ability to display stored 'video image' of cardholder, and switch real-time camera to card reader location for specific card usage.
- .10 Overall control of CCTV provided through software control, which provides complete integration of security components.
- .11 Environment: Design video components and systems to operate with all specified requirements under following ambient temperatures:
 - .1 Indoor installations:
Temperature: 0° C to 30° C.
Humidity: 10 to 90%.
 - .1 Outdoor installations:
 - .1 Temperature: -40° C to 60° C.
 - .2 Humidity: 10 to 100%.

1.6 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00.
 - .2 Shop Drawings: Submit in accordance with Section 01 33 00.
 - .1 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme including:
 - .1 Functional description of equipment.
 - .2 Technical data sheets of all devices.
 - .3 Device location plans and cable lists.
 - .4 Video camera surveillance chart.
 - .5 Video interconnection detail drawings.
 - .6 Wiring and riser diagrams.
 - .3 Samples: Submit in accordance with Section 01 33 00.
 - .1 Submit one sample of each camera selected complete with housing, brackets and mounting hardware.
 - .2 Camera will be returned for incorporation into work as appropriate.
 - .4 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00.
 - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit UL Product safety Certificates.
 - .2 Submit verification Certificate that service company is "UL List alarm service company".
 - .3 Submit verification Certificate that monitoring facility is "UL Listed central station".
 - .4 Submit verification Certificate that video surveillance system is "Certified alarm system".
 - .3 Instructions: Submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.
 - .5 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00. Include following:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions on operation, adjustment and cleaning.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Manufacturer's operation instructions.
-

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Deposit packaging materials in appropriate container on site for recycling or reuse.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard.
- .4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin.

1.8 WARRANTY

- .1 Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

Part 2 PRODUCTS

2.1 CAMERA - INDOOR NETWORK COLOUR DOME

- .1 **GENERAL** The dustproof, tamper proof indoor colour dome camera with integral pan/tilt/zoom is used in indoor security surveillance and assessment applications. The camera is normally flush mounted in the ceilings with only the dome being visible. An optional smoked dome must be available for use in locations where it is necessary to conceal the actual camera viewing position. With the camera being mounted in "difficult to access" locations, reliability and ease of maintenance are essential.
 - .2 **Environmental Requirements** The enclosure and subassemblies shall operate over the following conditions:
 - .1 Temperature: 0° C to +50° C; and,
 - .2 Humidity: 0 to 95%, non-condensing.
 - .3 Protection rating: IP65 or better
 - .3 **POWER REQUIREMENTS** The camera shall be PoE powered in accordance with IEEE 802.3af. and continuous duty cycle.
 - .4 **MECHANICAL REQUIREMENTS** The camera dome enclosure shall not exceed:
 - .1 Dome Diameter: 200 mm;
 - .2 Height: 250 mm (including dome);
 - .3 Weight: 2.5 kg;
 - .4 Construction: vandal resistant to 1000kg impact;
 - .5 Orientation: vertical or horizontal; and,
 - .6 Mounting: optional pendant kit.
 - .5 **DESIGN REQUIREMENTS:**
 - .1 Dome shall be an acrylic hemisphere with distortion free viewing.
 - .2 Cables between the enclosure and the control unit shall be kept to a minimum.
 - .3 The video signal must be transferred from the moving camera mount to the main equipment body via a non-contact system. Mechanical slip rings are not acceptable for video transfer.
-

- .4 All equipment shall be designed to high quality standard and have a life expectancy of at least five years.
 - .5 Enclosure shall have a label permanently affixed to the interior of the unit which identifies the manufacturer, the model or assembly number, the serial number and the mains power requirement.
 - .6 The colour camera shall utilize an interline transfer Charge-Coupled Device (CCD) or Complementary Metal Oxide Semiconductor (CMOS) pick up device.
 - .7 The electronic circuits shall use solid state devices with Digital Signal Processing (DSP).
 - .8 The camera shall have a built-in character generator for camera location identification.
 - .9 The camera and dome shall be of compact size and lightweight.
 - .10 All the controls and test points used during calibration, set-up and testing shall be easily accessible and permanently labelled.
 - .11 The unit shall be modular with plug-in circuit cards and assemblies.
 - .12 The unit shall be of high quality construction standard and have a designed MTBF (Mean Time Between Failure) of at least 5 years.
 - .13 Labels must be permanently affixed to the exterior of the unit which identifies the manufacturer, the model or assembly number, the serial number and the mains power requirement.
 - .14 Openings for conduits shall be threaded and any unused openings shall be sealed with a threaded plug which is secured from inside the dome with a set-screw.
 - .15 All externally accessible screws shall use tamper proof heads.
 - .6 TECHNICAL REQUIREMENTS The colour camera shall meet all applicable EIA Standards and the following minimum specifications:
 - .1 Support: Genetec Omnicast compatible driver requiring only one camera licence;
 - .2 Image Sensor: 1/3 inch or larger;
 - .3 Resolution : minimum 1280 x 960 pixels;
 - .4 Frame Rate (Var): at least to 30 fps (M-JPEG);
 - .5 Bandwidth: Adjustable with constant and variable bit rate support;
 - .6 Image Quality: Adjustable quality for all compression methods;
 - .7 Compression: M-JPEG and at least one of MPEG-4, H.263 and H.264;
 - .8 Video Streams: Minimum of two (2) simultaneous outputs;
 - .9 Video Features: Provide virtual pan/tilt/zoom within the video streams;
 - .10 Review Features: Provide either playback de-warping or playback virtual pan/tilt/zoom
 - .11 Compression Options: Shall provide configuration of the video encoder to select compression features;
 - .12 Sensitivity: Colour 1 lux scene illumination at 1/60s and black and white 0.1 lux scene illumination at 1/60s;
 - .13 AGC: yes;
 - .14 Lens: integral to camera (varifocal) wide angle lens shall have an angle of view of 34°-72° telephoto lens shall have an angle of view of 17°-54°;
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- .15 Angular Field of View: minimum angle of view 180° x 160°;
 - .16 SNR: >45 dB (AGC off);
 - .17 Image Stabilization: the camera shall be equipped with electronic image stabilization;
 - .18 Interface: RJ-45, 10/100Base-T, PoE;
 - .19 Protocol : TCP/IP (Ethernet)
- .7 FUNCTIONAL REQUIREMENTS,
- .1 The enclosure shall be tamper proof and use secure screws to allow access to the enclosure for maintenance purposes.
 - .2 Air intakes used for ventilation shall be properly filtered to prevent dust, water or insects from entering the enclosure.
 - .3 All assemblies shall provide 10,000 hours or more Mean Time Between Failure (MTBF) and be built for high reliability.
 - .4 All assemblies within the enclosure must be accessible for ease of maintenance.
- .8 INTERFERENCE Performance of the indoor dome enclosure and the video quality shall not be affected by the use of standard electronic equipment at the institution. Distance limits of standard electronic equipment are as follows:
- .1 5 watt CB transceivers at 1 metre or more;
 - .2 6 watt VHF and UHF transceivers at 1 metre or more;
 - .3 25mW 420-430 MHz Personal Portable Transmitters at 1 metre or more;
 - .4 Other radio frequency transmitting, receiving and distribution equipment at 5 metres or more; and,
 - .5 Personal computer and/or computer work stations at 5 metres or more.
- .9 SAFETY The dome enclosure must be CSA, UL, ULC or CE approved, as required by law.

2.2 CAMERA - OUTDOOR NETWORK COLOUR DOME

- .1 GENERAL The dustproof, tamper proof outdoor colour dome camera is used in outdoor security surveillance and assessment applications. The dome enclosure is mounted on roof tops and/or on building walls being subjected to high winds, various lighting and extreme weather conditions. Enclosure stability and effective operation during adverse lighting and weather conditions are essential. With the enclosure being located in "difficult to reach" locations, high reliability and ease of maintenance are also essential.
- .2 ENVIRONMENTAL REQUIREMENTS The enclosure shall meet the requirements of IP66, and the enclosure and subassemblies shall meet all operational requirements under the following weather conditions:
 - .1 Temperature: -40° C to +50° C;
 - .2 Humidity: 0 to 100%, condensing; and,
 - .3 Precipitation: rain, snow, hail to 2.5 cm diameters; and,
 - .4 Wind: 100 km/hour.
- .3 POWER REQUIREMENTS, The camera shall use VAC power within the following limits:
 - .1 Voltage: = 24 VAC ±10% @ 60 Hz ±1.5%; or = 24 VDC;

- .2 Power: power consumption shall not exceed 25 watts. It is preferable that the camera, and any internal heaters, be PoE powered.
 - .4 MECHANICAL REQUIREMENTS, The camera dome enclosure shall not exceed:
 - .1 Dome Diameter: 150 mm;
 - .2 Height: 250 mm (including dome);
 - .3 Weight: 7.5 kg; and,
 - .4 Duty Cycle: continuous.
 - .5 DESIGN REQUIREMENTS:
 - .1 Dome shall be an acrylic hemisphere with distortion free viewing.
 - .2 Cables between the enclosure and the control unit shall be kept to a minimum.
 - .3 The video signal must be transferred from the moving camera mount to the main equipment body via a non-contact system. Mechanical slip rings are not acceptable for video transfer.
 - .4 All equipment shall be designed to high quality standard and have a life expectancy of at least five years.
 - .5 Enclosure shall have a label permanently affixed to the interior of the unit which identifies the manufacturer, the model or assembly number, the serial number and the mains power requirement.
 - .6 The colour camera shall utilize an interline transfer Charge-Coupled Device (CCD) or Complementary Metal Oxide Semiconductor (CMOS) pick up device.
 - .7 The electronic circuits shall use solid state devices with Digital Signal Processing (DSP).
 - .8 The camera shall have a built-in character generator for camera location identification.
 - .9 The camera and dome shall be of compact size and lightweight.
 - .10 All the controls and test points used during calibration, set-up and testing shall be easily accessible and permanently labelled.
 - .11 The unit shall be modular with plug-in circuit cards and assemblies.
 - .12 The unit shall be of high quality construction standard and have a designed MTBF (Mean Time Between Failure) of at least 5 years.
 - .13 Labels must be permanently affixed to the exterior of the unit which identifies the manufacturer, the model or assembly number, the serial number and the mains power requirement.
 - .14 Openings for conduits shall be threaded and any unused openings shall be sealed with a threaded plug which is secured from inside the dome with a set-screw.
 - .15 All externally accessible screws shall use tamper proof heads.
 - .6 TECHNICAL REQUIREMENTS, The colour camera shall meet all applicable EIA Standards and the following minimum specifications:
 - .1 Image Sensor: 1/4 inch or larger;
 - .2 Resolution : minimum VGA (640 x 480 pixels) at 30 images/second;
 - .3 Frame Rate (Var): adjustable from 1 frame/second to 30 frames/second;
 - .4 Bandwidth: Adjustable;
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- .5 Image Quality: Adjustable;
 - .6 Compression: Intraframe coding (MJPEG);
 - .7 Compression Options: Shall provide configuration of the video encoder to select compression features;
 - .8 Sensitivity: 0.1 fc scene illumination at f1.4;
 - .9 AGC: yes;
 - .10 Lens: integral to camera (varifocal 2.8mm to 22mm, this range may be covered with several lens, based on 1/3 inch imager);
 - .11 Iris: F1.4 - F20, automatic with manual override;
 - .12 Angular Field of View: minimum 5° to 45° (H);
 - .13 Focus: automatic with manual override;
 - .14 SNR: >45 dB (AGC off);
 - .15 Distortion: <2% of picture height;
 - .16 Day/Night: the camera shall be equipped with an IR cut off filter for night use;
 - .17 Image Stabilization: the camera shall be equipped with electronic image stabilization;
 - .18 Interface: 10Base-T/100Base-T;
 - .19 Protocol : Internet interface protocol; and,
 - .20 Character Generator: =8 characters.
- .7 FUNCTIONAL REQUIREMENTS:
- .1 The enclosure shall be tamper proof and use secure screws to allow access to the enclosure for maintenance purposes.
 - .2 Air intakes used for ventilation shall be properly filtered to prevent dust, water or insects from entering the enclosure.
 - .3 All assemblies shall provide 10,000 hours or more Mean Time Between Failure (MTBF) and be built for high reliability.
 - .4 All assemblies within the enclosure must be accessible for ease of maintenance.
- .8 INTERFERENCE:
- .1 Performance of the outdoor dome enclosure and the video quality shall not be affected by the use of standard electronic equipment at the institution. Distance limits of standard electronic equipment are as follows:
 - .2 CB transceivers at 1 metre or more;
 - .3 VHF and UHF transceivers at 1 metre or more;
 - .4 Other radio frequency transmitting, receiving and distribution equipment at 5 metres or more; and,
 - .5 Personal computer and/or computer work stations at 5 metres or more.
- .9 SAFETY:
- .1 The dome enclosure must be CSA, UL, ULC or CE approved, as required by law.
- 2.3 NETWORK VIDEO RECORDER**
- .1 GENERAL:

- .2 NVRs are used in security surveillance and assessment applications in institutions. The NVR records real time video and audio streams transmitted from network video cameras or NTSC-IP Video Converters.
- .2 ENVIRONMENTAL CONDITIONS:
 - .1 The system shall meet all operational requirements over the following operating range:
 - .1 Temperature: 5° C to 40° C; and,
 - .2 Humidity: 20 - 80% non-condensing.
 - .3 POWER REQUIREMENTS:
 - .1 The equipment shall use standard commercial VAC power within the following range:
 - .1 Voltage: 120 VAC ±10%;
 - .2 Frequency: 60 Hz ±1.5%; and,
 - .3 Power: power consumption shall not exceed 600 watts.
 - .4 MECHANICAL REQUIREMENTS:
 - .1 The dimensions and weight shall not exceed the following:
 - .1 Width: to fit standard 19" rack mount;
 - .2 Height: maximum 6RU (Rack Units);
 - .3 Depth: 600 mm; and,
 - .4 Weight: 30 kg.
 - .5 DESIGN REQUIREMENTS:
 - .1 The unit must be self contained.
 - .2 The unit must fit in a standard 19 " rack.
 - .3 The NVR shall be based on common off-the-shelf computers and operating systems.
 - .4 Allfunction controls for NVR configuration and operation shall be available through remote access software.
 - .5 Power Failure Recovery shall enable the NVR to resume functioning in the same state that it was in at the time of the power failure.
 - .6 Memory Backup shall protect timer settings in the event of power failure.
 - .7 All test points on the NVR shall be clearly labelled and easily accessible for calibration and maintenance.
 - .8 All equipment shall be modular with plug-in circuit cards and assemblies.
 - .9 The design Mean Time Between Failure(MTBF) shall be at least 10,000 hours.
 - .10 The unit shall provided remote diagnostics to indicate recording failure or video loss from an IP camera or IP encoder.
 - .11 The recorder shall utilize user login, password and rights management such as to limit users' access to specific cameras, both live and recorded.
 - .12 The recorder system shall provided user rights and priorities to control of P/T/Z cameras.

.6 TECHNICAL REQUIREMENTS:

- .1 The NVR shall meet the following requirements:
 - .1 Video Format: Determined by camera;
 - .2 Audio: Synchronized with video input (when equipped);
 - .3 System Recording Rate: up to 120 Mbits/sec;
 - .4 Recording Frame Rate: maximum 20 simultaneous inputs @ 640 x 480 pixels, 30 frames per second per input;
 - .5 Recording Capacity: Shall have the ability to connect to external local RAID storage drives to a minimum of 4 external RAID chassis. Limited only by hard drive capacity;
 - .6 Primary Storage: Hot Swappable Hard Drives (capacity as per STR);
 - .7 RAID 5: Internal storage shall be 2TB RAID 5 as a minimum (depending on storage requirement);
 - .8 Watermark: The video must contain some form of watermark or fingerprint so that any attempt to tamper with the recorded digital image may be detected.
 - .9 Interface: 100 Base-T/10Base-T (auto fallback);
 - .10 Protocol: Internet Interface Protocol; and,
 - .11 User Display: HTML-based GUI.
 - .12 Failure Indication: Message to the FAAS when NVR stops recording for any reason.
 - .13 Fail-Over Archiving To be provided (The RAID 5 feature of the NVR is NOT considered redundant archiving. Additional archiver(s) that will automatically take over recording of the cameras assigned to an NVR that has completely or partially failed, in excess of a single RAID Drive, must be provided.)
 - .14 Fail-Over Directory To be provided (The Fail-Over Directory may reside on the Fail-Over Archiver).
 - .15 Operating System The operating system for the unit shall be contained on two (2) solid state drives configured as RAID 1 storage. The OS shall NOT be installed on the RAID 5 video array.

.7 INTERFERENCE:

- .1 The NVR performance and video quality shall not be affected by the presence or use of standard CSC electronic equipment. The units shall work at the following distance limits:
 - .1 CB transceivers at 1 metre or more;
 - .2 VHF or UHF transceivers (25W) at 1 metre or more;
 - .3 Other radio frequency transmitting, receiving and distribution equipment at 5 metres or more; and,
 - .4 Personal computers and/or computer work stations at 5 metres or more. The NVR shall not interfere with any standard electronic equipment used at the institutions.

.8 SAFETY:

- .1 The NVR must be CSA, UL, ULC or CE approved, as required by law.

2.4 LED COLOUR COMPUTER MONITOR

.1 GENERAL:

- .2 The LED colour computer monitor is used in indoor and outdoor security surveillance and assessment systems. It is mounted in standard EIA 19 inch racks, attached to walls and ceilings by brackets, and/or is located on desks and shelves.

.2 ENVIRONMENTAL REQUIREMENTS:

- .1 The LED colour computer monitor shall meet all operational requirements over the following operating ranges:

- .1 Temperature: 5 ° C to +40° C; and,
- .2 Humidity: up to 95% non-condensing.

.3 POWER REQUIREMENTS:

- .1 The monitor shall use standard single phase commercial VAC power within the following limits:

- .1 Voltage: 120 V AC \pm 10%;
- .2 Frequency: 60 Hz \pm 1.5%;
- .3 Transients: up to five times nominal voltage for up to 100 msec durations. Changes in the input power or any fluctuations within the above limits shall not cause damage to the unit; and,
- .4 Power: power consumption up to 45 watts.

.4 MECHANICAL REQUIREMENTS:

- .1 Free standing monitor cabinets shall be metal or metal with plastic front.
- .2 Rack mounted units shall be metal, and come complete with all hardware required to install in standard EIA 19" racks.
- .3 External dimensions, weight, diagonal effective viewing area and mounting configuration of the monitors are application dependent. These requirements shall be specified in the functional specification for the specific application.
- .4 All controls and test points used during calibration and testing shall be easily accessible and permanently labelled.

.5 DESIGN REQUIREMENTS:

- .1 All controls for the operation of the monitor shall be on the front of the unit and shall be easy accessible to the operator.
- .2 There must be clear permanent labelling of and easy access to all controls and test points used for calibration and testing by maintenance staff.
- .3 Where applicable, the monitor must be modular with plug-in circuit cards and assemblies. A standard extender board must be included with the equipment if applicable.
- .4 The monitor must be designed and built to high quality standards and have a Mean Time Between Failure (MTBF) of at least five years.

- .5 Labels must be permanently affixed to the exterior of the monitor which identify the manufacturer, model number, serial number and the power requirements.
- .6 TECHNICAL REQUIREMENTS:
 - .1 The colour computer monitor shall meet the following minimum requirements:
 - .1 Minimum Resolution: 1920 x 1080;
 - .2 Brightness: ≥ 2.5 cd/m²;
 - .3 Contrast Ratio : 3000:1;
 - .4 Aspect Ratio: 16:9;
 - .5 Response time: 5ms or better
 - .6 Viewing Angle: minimum 178° Horizontal; minimum 178° Vertical;
 - .7 Display: Thin Film Transfer, active matrix, LCD; and,
 - .8 Input Connectors: D-Sub & HDMI;
 - .9 VESA compliant mounts
 - .7 FUNCTIONAL REQUIREMENTS:
 - .1 The monitor shall provide a visual indication of power on/off.
 - .2 Front panel controls shall be easy accessible to the operator and include the following functions: Power on/off; Contrast; Brightness; Tint; and Colour.
 - .8 INTERFERENCE:
 - .1 Performance of the monitor and video quality shall not be affected by the presence and use of standard electronic equipment used at the institution. Distance limits of standard electronic equipment are as follows:
 - .1 CB transceivers at 1 metre or more ;
 - .2 VHF and UHF transceivers at 1 metre or more;
 - .3 Other radio frequency transmitting, receiving and distribution equipment at 5 metres or more;
 - .4 Personal computer ad/or work stations at 5 metres or more.
 - .9 SAFETY:
 - .1 The colour monitor must be CSA, UL, ULC or CE approved, as required by law.

2.5 NETWORK VIDEO USER STATION

- .1 GENERAL:
 - .2 NVUSs are used in security surveillance and assessment applications in institutions. The NVUS provides control and monitoring of CCTV equipment in a client-to-server configuration. The system shall use common off-the-shelf operating systems and computers. The system shall require user login and passwords to view recorded and live video. User video access and priorities are defined in the system configuration. The system shall be capable of having a minimum of 32 NVUS stations logged into the system.
- .2 ENVIRONMENTAL CONDITIONS:
 - .1 The system shall meet all operational requirements over the following operating range:

- .1 Temperature: 5q C to 40q C; and,
- .2 Humidity: 20 t o 80% relative, non- condensing.
- .3 **POWER REQUIREMENTS:**
 - .1 The equipment shall use standard commercial VAC power within the following range:
 - .1 Voltage: 120 V AC \pm 10%;
 - .2 Frequency: 60 Hz \pm 1.5%; and
 - .3 Power: power consumption shall not exceed 400 watts.
- .4 **MECHANICAL REQUIREMENTS:**
 - .1 The dimensions and weight shall not exceed the following:
 - .1 Width: 450 mm;
 - .2 Height: 200 mm;
 - .3 Depth: 450 mm; and,
 - .4 Weight: 30 kg.
- .5 **DESIGN REQUIREMENTS:**
 - .1 The unit must be self contained and the NVUS computer must fit in a standard 19" rack.
 - .2 The control functions must be usable with either a mouse or LCD touch screen.
 - .3 Memory Backup shall protect timer settings in the event of power failure.
 - .4 All test points on the NVMS computer shall be clearly labelled and easily accessible for calibration and main tenance.
 - .5 All equipment shall be modular with plug-in circuit cards and assemblies.
 - .6 The design Mean Time Between Failure (MTBF) shall be at least 10,000 hours.
 - .7 Emergency repair or parts and labour for detective NVMSs shall be available within 24 hours after notification of equipment unserviceability to any authorized dealer service centres across Canada.
- .6 **TECHNICAL REQUIREMENTS:**
 - .1 The NVUS shall meet the following requirements:
 - .1 Video Format: NTSC (colour and black/white);
 - .2 Video Frame Rate: 30 frames/second /channel (max);
 - .3 Video Freeze: yes.
 - .4 Video Output: SVGA;
 - .5 Audio: Synchronized with video input;
 - .6 Interface: 100 Base-T/10Base-T (auto fallback); and,
 - .7 Protocol: Internet Interface Protocol.
- .7 **FUNCTIONAL REQUIREMENTS:**
 - .1 The NVUS shall interface to the network and provide access and control of all CCTV surveillance and assessment systems as follows:
 - .1 General:

- .2 The provided NVUS will display up to 8 images on two monitors or a maximum of 9 images on a single monitor. The monitors will be fed video signal directly from the associated NVUS or via a video extension device.
 - .3 The operator will not have access or control over display of the NVUS.
 - .4 User login shall be through password protection that limits the user to specific cameras, both live and recorded.
 - .5 The Graphic User Interface (GUI) shall provide mapping functions to display camera locations. Cameras can be selected by camera number, or by dragging and dropping to a display.
 - .6 Alarms shall be able to be displayed on the map or through a text message.
 - .7 The system shall log all user operations.
 - .8 Viewing:
 - .9 Ability to have live and recorded viewing of a minimum of 16 cameras.
 - .10 Full control of all Pan/Tilt/Zoom (P/T/Z) cameras through user login of access rights to predefined cameras. Minimum of 16 priority levels to access cameras.
 - .11 Ability to set up guard tour and multiple camera sequences.
 - .12 Ability to display video in single, quad or step format.
 - .13 Full duplex audio capability. The GUI application provides the ability to control talk paths and listen to audio inputs at camera locations.
 - .14 Any live or recorded camera in the system shall be accessible through the single GUI interface without the need to change screens or applications.
 - .15 Recording:
 - .16 Ability to set record mode to automatically start recording on any appropriate alarm input, for example, a signal from the Fence Detection System.
 - .17 Ability to set record mode to stop when it receives any reset signal (one input per video input);
 - .18 Ability to manual initiate record mode.
 - .19 Ability to initiate record mode on motion.
 - .20 Ability to initiate record mode based on time.
 - .21 Ability to be configured to stop recording when the hard drive is full, or configured to overwrite the oldest files.
 - .22 Provide an open or closed contact when the NVUS stops recording for any reason.
 - .23 Playback:
 - .24 Ability to control playback speed.
 - .25 Ability to have multiple view playback.
 - .26 Ability to export single images and video sequences.
 - .27 Ability to search for motion in continuous recordings.
 - .28 Ability to search video sequences based on either date, time or motion.
 - .29 System:
 - .30 Capable of triple x operation: record, search and playback simultaneously.
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- .31 Placing the unit into either the Search or Playback mode shall not interrupt any recording in process.
 - .32 Searching and viewing of stored images, and reconfiguration of system parameters shall be available via a TCP/IP connection through a LAN. Any remote access software required shall be provided for installation on a standard Windows based computer; and,
 - .33 Transfer viewing software automatically to the CD when downloading audio and video for archive purposes. It should be possible to review the archived audio and video from any CSC PC with Windows XP without additional software.
 - .34 Should indicate Power on/off; Hard Drive Full Alarm; Time/Date; and Recording; on the operator console;
 - .35 Should have controls for Power on/off; Record; Play/Stop; Forward/Reverse Field Advance; Time, Date and Recording Mode on the operator console;
 - .36 Control signals available on the back of the NVUS shall include Automatic Alarm Input; and Manual Alarm Input;
 - .37 System messages must be contained in a log file available for downloading or printing.
 - .38 Multiple users shall be able to share common resources, with individual users being assigned different system access capability with password protection.
- .8 INTERFERENCE:
- .1 The NVUS performance and video quality shall not be affected by the presence or use of standard CSC electronic equipment. The units shall work at the following distance limits:
 - .2 CB transceivers at 1 metre or more;
 - .3 VHF or UHF transceivers (25W) at 1 metre or more;
 - .4 Other radio frequency transmitting, receiving and distribution equipment at 5 metres or more; and,
 - .5 Personal computers and/or computer work stations at 5 metres or more. The NVUS shall not interfere with any standard electronic equipment used at the institutions.
- .9 SAFETY:
- .1 The NVUS must be CSA, UL, ULC or CE approved, as required by law.

2.6 SIO NVUS CLIENTS

- .1 The contractor shall supply and install 2 complete network clients that meet or exceed all of the requirements detailed in ES/STD-0228 with the following inclusions:
 - .1 Monitor – The contractor will provide 4x32” (identical) LED desktop monitors (2 per client).

- .2 Client CPU – The clients supporting these monitors will be a tower style PC located with the monitor in a workstation configuration. The client will produce no more than 50db sound pressure @ 24". The client will be equipped with the following as a minimum:
 - .1 8GB DDR3 RAM memory
 - .2 256GB SATA 3 6Gb/s solid state hard drive
 - .3 2TB 3.5", SATA 6Gb/s, 7200 RPM, 64MB Cache hard drive
 - .4 Dual DVI output video card with 1GB RAM memory and DirectX 9.0 support.
 - .5 Intel i7 quad core 3.4 GHz processor with 8MB cache memory.
 - .6 10/100/1000 Ethernet Network Interface Card
 - .7 Internal 24X DVD Writer - SATA Interface, 48X CD-R Write Speed
 - .8 Keyboard and Mouse Combo - 1000 DPI, Spill-resistant, Durable keys, Plug-and-play, USB
- .3 Configuration – The clients will be configured as SIO workstations, with access to all cameras in the institution. The workstation will have the Genetec live viewer and archive player applications installed as well as suitable software for burning CD and DVD optical disks for data removal. The OS and application will be loaded onto the SSD and the 2TB drive will be configured for local video storage.

2.7 ELECTRONIC EQUIPMENT CABINETS

- .1 Full height floor mount cabinets will meet the following criteria:
 - .1 Power distribution within a cabinet or rack shall be via three power outlet strips, as provided by the original cabinet or rack manufacturer. 2 x Horizontal power strips will have at least 5 outlets on the rear and at least 1 outlet on the front of each strip. Each strip shall have at least six outlets. 1 x vertical 20A power strip equipped with a twist lock plug and a minimum of 16 outlets.
 - .2 The Cabinet will be equipped with a dimmable, retractable front light for component illumination the light it will have 8 rear outlets, spaced to accommodate plug-in power supplies, it will be of a clean ground surge suppressor design will not pass noise contamination to the ground, and will also have two rear USB ports for use with the optional LED gooseneck work light (model # LT-GN)
 - .3 Vertical power strips shall be connected to "Emergency Power". This strip will be connected to the nearest emergency generator supported AC panel on an independent circuit. The circuit will be identified in the AC panel as "Electronic Security Systems – CCTV"
 - .4 Raised top for ventilation;
 - .5 Where a cabinet is installed into an electrical or mechanical room the cabinet will be equipped with cooling fans in the top or sides of the cabinet. These fans will provide a minimum of 150 CFM free air movement per 72" of cabinet height.
 - .6 Metal doors front and rear. Both doors fitted with locks, both locks keyed alike;
 - .7 Removable sides, where cabinet sides are accessible they will be equipped with keyed locks matching the keyway of the front and rear cabinet doors.
 - .8 Four adjustable levelling feet;
 - .9 Adjustable side rails for mounting equipment. EIA standard 19" width;

- .10 Minimum usable depth of 33.5", (36" outside depth). Minimum usable height of 73.5" with an overall height of 80". Minimum 42 usable rack spaces. Middle Atlantic WMRK-4236SVR or equivalent.
- .11 Except where otherwise specified differently in Annex C of this document.
- .2 Wall mount cabinets will meet the following criteria:
 - .1 Power distribution within the cabinet shall be via an installed 2 outlet connected to "Emergency Power". This strip will be connected to the nearest emergency generator supported AC panel on an independent circuit. The circuit will be identified in the AC panel as "Electronic Security Systems – CCTV"
 - .2 The cabinet will have a louvered front door for equipment airflow; the cabinet will be equipped with cooling fans in the top or sides of the cabinet. These fans will provide a minimum of 70 CFM free air movement.
 - .3 All doors fitted with locks, all locks keyed alike.
 - .4 Adjustable side rails for mounting equipment. EIA standard 19" width; equipment will mount vertically into the cabinet. Rack rails will be 180 degree adjustable for ease of equipment installation and maintenance.

2.8 STRUCTURED CABLE SYSTEMS

- .1 General:
 - .2 This document defines the quality control requirements for the design, installation, testing and acceptance of structured cable systems for use in security systems installed in all Correctional Service Canada (CSC) facilities.
- .2 Scope:
 - .1 This specification has been developed to ensure high standards for the installation of electronic systems. It defines workmanship standards which may not be fully covered in subsidiary specifications. All contractor's documentation and installation procedures shall meet this specification for equipment reliability, maintainability, longevity, appearance and operational use.
- .3 Off-The-Shelf Equipment:
 - .1 The contractor shall provide commercial off-the-shelf (COTS) equipment wherever possible. COTS equipment shall meet or exceed the manufacturing standards as listed in this specification.
- .4 Manufactured Equipment:
 - .1 Where COTS equipment is unavailable or unsuitable for a specific application, the contractor may manufacture or arrange for the manufacturing of a particular item to suit the requirements. Manufactured equipment shall meet or exceed the best commercial equipment manufacturing standards.
- .5 Commonality of Equipment:
 - .1 The contractor shall provide commonality of hardware components within the design parameters ie. switch locks, racks, panels etc. All equipment, if appropriate shall be interchangeable.

- .6 MATERIAL AND EQUIPMENT REQUIREMENTS:
- .1 Environmental Conditions:
- .1 All materials and equipment which is used in CSC installations shall be equal to, or better than the standards established in the original equipment and shall be chosen with due consideration being given to the intended use, safety, retention of appearance, maintainability and durability under rugged operating conditions. These materials shall be suitable to perform over the following environmental ranges:
- .2 Indoor Equipment Temperature: 0°C to 40°C; and Humidity: 20% to 95% non-condensing.
- .3 Outdoor Equipment Temperature: -40° C to +50° C; and Humidity: 0 to 100%, condensing. Outdoor equipment shall operate reliably and not be damaged by combinations of direct exposure to the sun, wind, rain, lightning, hail, snow and ice as may be expected to occur at each institution location. Complete assemblies of indoor equipment shall be resistant to liquid spills, air borne contaminants, shock and vibration.
- .7 TELECOMMUNICATIONS OVERVIEW:
- .1 Structured Cabling System The design objective is a flexible network that is easy to re-configure, easy to manage and capable of incremental growth. The network is based on a structured cabling system conforming to Electric Industry Association/Telecommunications Industry Association Specification 568 (EIA/TIA-568) and Canadian Standards Association 529 (CSA 529) and using a star wired topology for the horizontal distribution with Category 6 Unshielded Twisted Pair (UTP) and 50/125 Micron Laser Optimized Fibre. The design will support Ethernet, Fast Ethernet, and network management.
- .8 DESCRIPTION OF WORK:
- .1 General System Requirements:
- .1 Outline:
- .2 This section defines the minimum requirements for a structured cabling system to be provided on an engineered, furnished, installed, tested, and commissioned basis. Products and installation practices shall conform with the EIA/TIA documents identified in the APPLICABLE DOCUMENTS section of this Statement of Work. The structured cabling system includes the following basic elements arranged into backbone feeders and horizontal distribution subsystems that are cross connected or patched together in Telecom Closets or Common Equipment Rooms on Intermediate Distribution Frames (IDFs). a. Unshielded Twisted Pair (Horizontal) b. 8-pin modular Telecom outlets c. Insulation displacement connector type terminal blocks d. LOF optic cable (Backbone) e. Fibre optic (duplex) interconnect patch panels f. Patch cords for patch panels g. Line cords for workstation data equipment (Office Cables) Notes:
- .1 3 metre length is standard for Office Cables
- .2 All cables provided for a project shall have a BRIGHT GREEN jacket.

- .2 Horizontal Data Cable:
 - .1 Each cable shall consist of 8 each of 24 AWG thermoplastic insulated solid copper conductors formed into four individually twisted pairs and enclosed by a jacket with the appropriate protection rating determined by Provincial codes. The cable shall fully conform with EIA/TIA-568 design requirements for 100 ohm U TP cable and fully conform with EIA/TIA-2.7 TSB-36 transmission requirements for Category 6 cable. Cables shall bear evidence of verified Level 6 or Category 6 and also bear evidence of certification by a recognized standard or testing body. (eg: Bearing NORDX Brand name and have length clearly marked on cable sheath) The cable bundles will be fed to locations in either a supplied cable tray or conduit system. Outlet cables will then be fed to the user locations via either pac poles or fished down hard wall offices. A pull string will remain in the conduit/cable tray for future installations. The cable run length from the IDC to the workstation location shall NOT exceed 90 metres. The combined length for patch cords for data network horizontal distribution connections shall not exceed 10 metres for an overall length from data network hub equipment to workstation equipment not exceeding 100 metres.
 - .2 User Termination Termination at the user end will be made onto a certified Category 6 RJ45 module for data. These modules will then be housed in a certified faceplate. The faceplate to house the modules will have the capability to equip up to six each 8 pin modular jacks. Other configurations to be used will vary with locations: A duplex flush mount faceplate for drywall applications, a duplex surface mount kit for PAC pole applications and duplex single gang outlets mounted into custom furniture with adapter plates. Surface mount kits will not exceed a 6.5 cm. protrusion from the wall. For custom furniture it is assumed that the cable runs will be fed to the outlet via raceways in the legs of furniture. For security reasons, jacks are NOT be installed in exterior walls or walls not totally part of CSC space. All cables must either terminate on a patch panel or on a faceplate, loose or unterminated cables are not acceptable. The 8 pin modular jack connectors shall comply for termination of 4 wire pairs with 24 AAWG solid copper conductors: minimum contact force of 2.7 g and conductors separated by jack comb Each modular outlet will be wired per EIA/TIA-568 polarization sequence, designation T568A.
 - .3 Closet Termination Supply and installation of RJ45 Category 6 hardware for system connection in communications closet using 24 NT certified patch panels rack mounted with cable organizer panels installed for each patch panel. Active components will be connected to equipment by 8 conductor patch cords manufactured to CAT 6 compliance. Patch cords shall be stranded conductor and have a "no-snag" boot over the RJ45 connector. Multi-Level building installations will require individual patch panels be installed for each level of the building. Patch panel(s) for each level of a multi-level building must have at least 15% unused ports. The same holds true for single story, multi ICC buildings.
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- .4 Cable Protection All ceiling distribution cabling shall be enclosed and protected by 3/4" and 1" rigid conduit from communications closet(s) room(s) and cabinets to all user outlets located in inmate accessible areas. In areas that CSC designated as non inmate accessible, EMT zone conduit will be allowed. Conduits must have end bushings installed to protect the cable from sharp edges. Conduit containing Copper backbone cable must be designated "CAUTION SECURITY SYSTEM CABLE" Conduit containing Fibre Optic backbone cable must be designated "CAUTION FIBRE OPTIC SECURITY SYSTEM CABLE".
 - .5 Line Cords The cabling company will supply RJ45, 8 pin modular line cords to connect owner provided data equipment to the horizontal distribution outlets at the workstation. They must be consistent with CAT 6 specification and provide end-to-end CAT 6 connectivity. Line cords shall be stranded conductor and have a "no-snag" boot over the RJ45 connector.
 - .6 Testing All cables/pairs will be scanned with a MicroTest Penta cable scanner or equivalent at 100 Mbs to determine DC loop resistance, near end cross talk and attenuation to meet or exceed the performance stated in EIA/TIA TSB-36 and TSB-40, noise, pair mapping and ranking. These tests must be conducted as originating from both the punch down location and modular outlet location of each cable segment.
 - .7 Labeling All jacks must be identified by means of labels with unique numbers These markings will be made with printed labels. The Correctional Service of Canada expects that all drops at the user end will be sequential and not out of order. The closet terminations must be identified with these same numbers marked on BIX labels adhered to BIX 20A designation strips and patch panels. The CAN/CSA 568 colour code will apply. Labels will also be placed on the horizontal wire, 6-9" from termination points. This would include closets, main cabinet, and jacks.
 - .8 Documentation Customer to supply CAD or Visio Version 2.7 floor plans when available. If CAD documents are not available, contractor will be responsible to scan hard copy of plans. Contractor to supply site plans, individual runs, risers, wire #'s, jack #'s, patch panel #'s in both hard and soft copy . All test results shall be machine printed, hand written test result sheets are NOT acceptable.
- .3 Fibre Optic Backbone Cable:
- .1 Cable: The cable to be supplied and installed for backbone purposes shall consist of 12 strands (6 pairs) of Laser Optimized Fibre with nominal 50/2.7 um core/cladding diameter formed into a single cable. Optical cable shall physically conform with ANSI/ICEA S-83-5 2.8 mechanical and environmental specifications for outdoor fibre optic cable. Fibre optic cable shall conform with the requirements of OM3 as per the ISO 11801-2nd.9 Edition standards.
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- .2 Terminations Fibre optic cables shall be terminated to SC Physical contact Connectors shall be able to sustain a minimum of 200 mating cycles per EIA/TIA -455-21 without violating specifications . These connectors will terminate within interconnect sleeves to facilitate patching in patch panels. The maximum optical attenuation per pair of mated connectors shall not exceed 2.7 db. All fibre strands, whether used in the project or not, shall be terminated with SC type connectors and installed into a fibre patch panel: generally one duplex patch per cable (i.e. 12 connectors per panel for 12 strand fibre cable). Please note that these cables shall be SC to ST unless otherwise noted. The patch panel proposed shall provide strain relief for each fibre as an integral part of the panel design. This standard type and size of panel should be uniformly used throughout the project. Installed fibre panels shall be completed with all guides, brackets and other accessories to facilitate cable cross connect to active components for administration and management, including provisions for labeling that are consistent with E IA/TIA-568.
 - .3 Testing All terminated fibre media and related connecting hardware shall be tested with a power meter and certified at the conclusion of the initial installation with an OTDR, in both directions. Testing will include end-to-end attenuation testing that shall measure each fibre in one direction and compare with the calculated loss based on the manufacturers specifications and known length of cable using 850 nanometres and 1300 nanometres wavelegths. The difference in value between any two mated fibre shall not exceed 0.5 d b. The power levels of the terminated fibres shall be documented to allow the equipment vendor to select the correct strapping options for their equipment. This will prevent the receivers from being over loaded. If the attenuation measurements are not within the required specifications, an Optical Time Domain Reflectometer shall be used to find the cause and location of the power loss. Any failure will be rectified. All test results to be machine printed, and documented in duplicate and delivered complete with As-Built drawings to Corrections Canada Regional Office. The fibre optic cable testing will also include a basic light test: - on each of the fibres before installation to ensure that no damage had occurred during shipping; - on each of the fibres before termination to ensure that no damage had occurred during installation.
 - .4 Labeling All fibre optic cables will be identified by means of Warning Labels located on all related conduit, pullboxes and backboards. Both ends of all fibre cables will be labeled indicating destination and number of strands. All ports on each Fibre optic patch panel will be labeled to identify the backbone destinations. Both ends will be labeled with this same numbering scheme.
 - .4 Cross Connect:
 - .1 Data Cross-connect: Cross connection of the UTP horizontal cables to the tie field will be completed after testing of in stalled cables has taken place. Jumper wire shall be provided, if requested, and will conform with EIA/TIA TSB-40 transmission requirements for Category 6.
-

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install video surveillance equipment and components in accordance with ULC-S317.
- .2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .4 Connect cameras to cabling in accordance with installation instructions.
- .5 Install ULC labels where required.

3.3 STRUCTURED CABLING INSTALLATION

- .1 The contractor shall avoid, as much as possible, the use of conduit in inmate accessible areas. The contractor shall utilize existing pipe chases, existing conduit in the walls, etc., where possible. New lengths of conduit shall be of the minimum necessary length. All newly installed conduits carrying video for this project shall be identified, except in inmate accessible areas, by prominent labels with **BRIGHT GREEN** wording. These labels shall be located at each end of the conduit run, on both sides of any penetration of a wall, and at 3.5 metre points along its length. All junction box covers and conduit joints will be painted bright green except where installed in inmate accessible areas.
- .2 The use of flex conduit will only be permitted by written authorisation from the project authority on a case by case basis; the use of flex conduit is not permitted in inmate accessible areas.
- .3 In secure office areas where drywall construction is used the contractor will fish associated cabling to support KVM extension devices through the walls. The walls will be finished with an appropriate CAT6 termination plate, labeled to the device. ALL visible CAT6 RJ 45 plugs will be **BRIGHT GREEN**. When fishing cable into a wall the contractor may use flex conduit. Where it is impossible to fish the cable into a hollow wall or the wall is solid (e.g. cinderblock) the contractor may use a decorative wire mold to run the necessary cables to the defined location of the equipment. Wire mold will meet the Ontario Electrical Code when supporting power.
- .4 All data cables and data jumper cables (minimum 23 gauge), jacks and connector boots installed as part of this project, whether CAT6 or fibre optic, shall be **BRIGHT GREEN** in colour. All cables shall be FT4 rated except where cable is not protected in a conduit or in a plenum ceiling, such cable must meet a FT6 fire rating
- .5 All cabling in equipment cabinets, termination trays, cable trays, junction boxes, and at edge devices will be neatly dressed using Velcro style "hook and loop" re-useable straps. Cable straps must encircle all the cables in a given bundle. Any cable secured with a tie-wrap will require replacement of the entire cable.

- .6 All cabling in equipment cabinets will be dressed throughout the cabinet. Cables entering a cabinet from the top will be routed to the base of the cabinet and then return to the designated equipment height, the reverse for cables entering the bottom. Vertical cable runs in the cabinet will be in the side panel areas of the cabinet. Vertical cable runs will be strapped every 12 inches. Cable straps must encircle all the cables in a given bundle.
- .7 Cabling traveling horizontally to equipment will be supported by cable rails, cables will be fastened to the rail for support. Cable straps must encircle all the cables in a given bundle.
- .8 Cables travelling from one cabinet to another cabinet in the same room will be routed via a contractor provided and installed cable tray. The provided cable tray will run above all equipment cabinets and cables will drop vertically into the cabinet of destination. Diagonal cables will require replacement of the entire cable.
- .9 All fibre optic cabling installed will be 50/125 micron multi-mode OM3 fibre optic cable with a teal jacket. All fibre strands are to be terminated onto a fibre patch panel, rack mounted into the highest location in an electronics equipment cabinet.
- .10 All patch cables are to be stranded cable with RJ45 connectors.
- .11 All installed runs of CAT6 cable are to be solid conductor cable and terminated into patch panels in equipment racks or faceplates in other locations. Where an equipment cabinet is not available CAT6 cables may be terminated onto a mini patch field mounted into a self-contained, secure patch box. The patch box must be specifically designed to support the mini patch field. No more than 6 (quantity six) Category 6 (CAT6) cables may be terminated into a single mini patch field.
- .12 Where an installed cable is connected directly to a CCTV camera the cable will be terminated with a CAT6 RJ45 connector specifically designed for termination on a solid conductor CAT6 cable. All other CAT6 cabling will be terminated on high density CAT6 patch panels rack mounted into electronics equipment cabinets at the highest available location in the cabinet but not higher than fibre optic patch panels.
- .13 The contractor will integrate all hardware provided to the existing Genetec VMS, providing additional licensing where necessary. The contractor shall integrate alarms for the VMS into the PIU (Perimeter Integration Unit). The contractor will program the maps displays into the FAAS display of the Senstar 100 PIU. The PIU will provide live status, and alarm annunciation of the following system alarms:
 - .1 Camera video loss (all cameras connected to the Genetec VMS)
 - .2 Remote switch failure (all switches connected to the CCTV network)
 - .3 Network link loss (all nodes)
 - .4 UPS failure (all UPS units in all equipment cabinets)
 - .5 UPS AC loss (all UPS units in all equipment cabinets)
 - .6 Archiver failure, including but not limited to:
 - .7 Network connection loss
 - .8 Hard drive warning & hard drive failure
 - .9 Directory failure

Provide all necessary signal cables and connectors for PIU and Genetec VMS. Confirm with contractors.

Confirm existing locations for headend equipment for Genetec VMS and PIU systems.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Services:
- .2 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.
- .3 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.
- .4 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.
- .5 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.5 VERIFICATION

- .1 Perform verification inspections and test in the presence of Departmental Representative.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors, and manufacturer's representatives and security specialists are present for verification.
 - .2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
 - .6 Device and cabling identification.
 - .7 Application and location of ULC approval decals.
 - .3 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Measurements of tension and power.
 - .2 Connecting joints and equipment fastening.
 - .3 Measurements of signals (dB, lux, baud rate, etc).
 - .4 Compliance with manufacturer's specification, product literature and installation instructions.
 - .4 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
-

- .1 Operation of each device individually and within its environment.
- .2 Operation of each device in relation with programmable schedule and or/specific functions.
- .3 Operation control of camera lens, pan, tilt and zoom.
- .4 Switching of camera to any monitor.
- .5 Switching of system video recorder to selective monitor.
- .6 Set dwell times.
- .7 Demonstrate:
 - .1 Sequence viewing of cameras on each monitor.
 - .2 Bypass capability.
 - .3 Display of stored image to cardholder.

3.6 CLEANING AND ADJUSTING

- .1 Remove protective coverings from cameras and components.
- .2 Adjust cameras for correct function.
- .3 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Government of Canada:
 - .1 NBC-2005, National Building Code of Canada.
 - .2 TB OSH Chapter 3-03, 1997-01-28, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire Protection Electronic Data Processing Equipment.
 - .3 TB OSH Chapter 3-04, 1994-12-22, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Underwriter's Laboratories of Canada (ULC):
 - .1 CAN/ULC-S524-06, Installation of Fire Alarm Systems.
 - .2 ULC-S525-07, Audible Signal Appliances for Fire Alarm.
 - .3 CAN/ULC-S526-07, Visual Signal Appliances, Fire Alarm.
 - .4 CAN/ULC-S527-99, Control Units.
 - .5 CAN/ULC-S528-05, Manual Pull Stations.
 - .6 CAN/ULC-S529-02, Smoke Detectors.
 - .7 CAN/ULC-S530-M91, Heat Actuated Fire Detectors.
 - .8 CAN/ULC-S531-02, Smoke Alarms.
 - .9 CAN/ULC-S536-04, Inspection and Testing of Fire Alarm Systems.
 - .10 CAN/ULC-S537-04, Verification of Fire Alarm Systems.

1.2 SYSTEM DESCRIPTION

- .1 Expansion of existing building fire alarm system to accommodate new zones, devices, panels etc.
 - .2 Include:
 - .1 Modifications to the existing Simplex 4120/4100U/4100ES System Network.
 - .2 Upgrade sub panel in room A105.
 - .3 Addressable IDNet loops, initiating devices.
 - .4 Notification Bell & Strobe circuits.
 - .5 Auxiliary circuits.
 - .6 Wiring for a complete system.
 - .7 Manual and automatic initiating devices.
 - .8 Audible and visual signaling devices.
 - .9 End-of-line resistors.
 - .10 Local & remote Lcd & Led Annunciators.
 - .11 TrueSite Graphic Workstation. MCCP.
 - .12 History log for alarm, supervisory & trouble events.
 - .13 Update Active Graphic Annunciators, MCCP & B151.
-

- .3 System components: listed by ULC and comply with applicable provisions of National Building Code, Ontario Building Codes, and meet requirements of local authority having jurisdiction.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Include:
 - .1 Detailed equipment literature and information on all control equipment and devices comprising of the complete system.
 - .2 Overall system riser wiring diagram identifying control equipment, addressable data loops, initiating circuits, signaling circuits; identifying necessary wiring information.
 - .3 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
 - .4 Detailed sequence of operation.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 00.
- .2 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Include:
 - .1 25 spare glass rods for manual pull stations.

1.6 MAINTENANCE AND WARRANTY

- .1 Provide 1 year warranty on all system equipment and components from the date of substantial completion.
- .2 Provide 3 copies of maintenance manuals to the owner at the completion of the project.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 11, and with the Waste Reduction Workplan.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
-

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to ULC-S524.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.
- .9 Smoke alarms: to CAN/ULC-S531.

2.2 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Modify and upgrade existing sub panel in room A105 to accommodate new zones, power supplies, devices, relays etc.
 - .2 Reprogram existing Simplex 4120/4100U/4100ES network software to accommodate new zones and devices etc.

2.3 POWER SUPPLIES

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.4 INITIATING/ INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as water flow switches, tamper switched, low pressure switches, etc wired in DCLB configuration to addressable monitor modules.
 - .2 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
 - .3 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".
-

2.5 NOTIFICATION (BELL & STROBE) CIRCUITS

- .1 Notification circuit: connected to devices, wired in class B configuration to central control unit.
 - .1 Bell circuits' operation to follow system programming; capable of sounding bells at the temporal (3-3-3) rate. Strobe circuit: rated at 2 amp, 24 VDC, continuous; complete with protection from overloading and overcurrent.
 - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.6 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Alarm activations on system to cause operation of programmed auxiliary output circuits.
- .3 Provide separate contacts for elevator homing and to alternate floor homing as required by the elevator supplier.
- .4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .5 Auxiliary circuits: rated at 2 A, 24 Vdc or addressable relays only rated for 5A @ 120 Vac, fuse-protected. Dual voltage relays to be provided as required.

2.7 WIRING

- .1 Copper conductors: rated 300V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 Network communication & addressable data loops: 18 AWG minimum, twisted and shielded, in accordance with the manufacturer's requirements.

2.8 MANUAL ALARM STATIONS

- .1 Addressable manual alarm stations: pull lever, glass rod, wall mounted, semi-flush type, non-coded, bilingual signage.
 - .1 Manual pull station to be 2-stage type utilizing a key to operate the 2nd stage.
 - .2 Pull station shall be robust and of metal construction.

2.9 AUTOMATIC ALARM INITIATING DEVICE

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 88°C, rate of rise 8.3°C per minute.
 - .1 Electronics to communicate detector's status to addressable module in the central control unit.
-

- .2 Detector address to be set on detector base in field.
- .2 Smoke detector: photo-electric air duct type with sampling tubes with protective housing.
 - .1 Plug-in type with fixed base.
 - .2 Wire-in base assembly with integral red alarm LED, and terminals for remote alarm LED.
- .3 Addressable variable-sensitivity smoke detectors.
 - .1 Photo-electric type.
 - .2 Electronics to communicate detector's status to addressable module in the central control unit.
 - .3 Detector address to be set on detector base in field.
 - .4 Sensitivity settings: 5 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
 - .5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.10 AUDIBLE SIGNAL DEVICES

- .1 Bells: wall mounted, vibrating, supervised, 24 V dc, 250 mm as indicated on drawings, minimum 85 db.
- .2 Wiring to be DCLB to the central control unit.

2.11 VISUAL SIGNAL DEVICES

- .1 Strobe type: flashing, red housing, 24 V dc.
- .2 Designed for surface mounting on ceilings or walls as indicated.
- .3 Wiring to be DCLB to the central control unit.

2.12 END-OF-LINE DEVICES

- .1 End-of-line devices to control supervisory current in monitoring and signalling circuits, sized to ensure correct supervisory current for each circuit. Open ,short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at the central control unit and all remote annunciators.

2.13 REMOTE ANNUNCIATORS

- .1 Lcd & Led displays , with appropriate designations to indicate zones.
- .2 Display:
 - .1 Alarms for alarm initiating circuits.
 - .2 Supervisory alarms for supervisory initiating circuits.
 - .3 Common system trouble.
- .3 Trouble buzzer.
 - .1 Acknowledging trouble at main panel to silence trouble buzzers in system.
- .4 Supervised, DCLB style wiring.

- .5 Modify existing annunciators in the main complex at B151, MCCP and Segregation Post.
- .6 Provide new annunciator in expansion.

2.14 GRAPHIC

- .1 Modify existing active graphics in the main complex at B151 and MCCP.
- .2 Provide new active graphic at new annunciator panel.

2.15 REMOTE PRINTER

- .1 System printer: update programming so that existing network system printer will record new building system events (alarm, supervisory, trouble conditions) at Maintenance building.

2.16 REMOTE COMPUTER WORK STATION

- .1 Update existing TrueSite workstation in the main complex at MCCP.

2.17 ANCILLARY DEVICES

- .1 Relay devices to initiate fan shutdown.
- .2 Relay devices to initiate door release.
- .3 Relay devices for elevator homing.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
 - .2 Modify existing control equipment to accommodate new expansion.
 - .3 Install manual alarm stations and connect to alarm circuit wiring.
 - .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
 - .5 Connect alarm circuits to central control unit.
 - .6 Install bells and visual strobe devices and connect to signalling circuits.
 - .7 Connect signalling circuits to central control unit.
 - .8 Install end-of-line devices for DCLB circuits.
 - .9 Install remote annunciator panels and connect to annunciator circuit wiring.
 - .10 Install door releasing devices.
 - .11 Install remote relay units to control fan shut down.
 - .12 Sprinkler system: wire alarm and supervisory switches and connect to central control unit.
 - .13 Splices are not permitted.
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- .14 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .15 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .16 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 and CAN/ULC-S537.
- .2 Fire alarm system:
 - .1 Test such device and alarm circuit to ensure manual stations, thermal, smoke detectors, sprinkler system devices, transmit alarm to control panel and actuate single stage alarm, ancillary devices.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
 - .4 Addressable circuits system style DCLA:
 - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

3.3 DEMONSTRATION AND TRAINING

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION

Part 1 GENERAL

1.1 WORK INCLUDED

- .1 Excavation and backfilling for site services work is included in this Section. This work to be laid out and supervised by trade concerned.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .3 ASTM D751-06(2011), Standard Test Methods for Coated Fabrics.
- .2 CSA International
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A3000-08, Cementitious Materials Compendium.
- .3 Ontario Provincial Standard Specifications (OPSS)/Ontario Ministry of Transportation
 - .1 OPSS 401 November 2010 (formerly 514), Ontario Provincial Standard Specification, Construction Specification for Trenching, Backfilling, and Compacting.
 - .2 OPSS 1004 November 2006, Ontario Provincial Standard Specification, Material Specification for Aggregates - Miscellaneous.
 - .3 OPSS 1010 April 2004, Ontario Provincial Standard Specification, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.
- .4 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
 - .2 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.
 - .1 Pay costs of relocating services.
 - .2 Before commencing work verify location of buried services on and adjacent to site.
 - .3 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .4 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
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- .2 Examine soil report attached as appendix, titled Geotechnical Investigation Report, dated March 25 2011 by LVM.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Samples: submit to designated testing agency, 23 kg sample of backfill for fill material proposed for use, no later than 1 week before backfilling or filling work.
- .3 Site Quality Control Submittals: submit in accordance with Section 01 45 00.
 - .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article.
 - .2 Submit testing results and report as described in PART 3 - FIELD QUALITY CONTROL.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Refer to OPSS 1010.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Evaluation and Assessment:
 - .1 Examine soil report available as appendix.
 - .2 Before commencing work verify locations of buried services on and adjacent to site.

3.2 PREPARATION

- .1 Temporary erosion and sedimentation control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
 - .2 Protection of in-place conditions:
 - .1 Protect excavations from freezing.
 - .2 Keep excavations clean, free of standing water, and loose soil.
 - .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative's approval.
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- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.
- .3 Removal:
 - .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.
 - .2 Remove stumps and tree roots below footings, slabs, and paving, and to 300 mm below finished grade elsewhere.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

3.3 EXCAVATION

- .1 Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial and Municipal regulations whichever is more stringent.
- .2 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.
 - .1 Stockpile topsoil on site for later use.
- .3 Excavate as required to carry out work.
 - .1 Do not disturb soil or rock below bearing surfaces.
 - .2 Notify Departmental Representative when excavations are complete.
 - .3 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
 - .4 Excavation taken below depths shown without Departmental Representative's written authorization to be filled with concrete of same strength as for footings at Contractor's expense.
 - .5 Excavation, backfilling and compacting for installation of storm and sanitary pipe sewers, , pipe subdrains and other underground utilities in accordance with OPSS 401.
- .4 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground.
 - .1 Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .5 Excavate for slabs and paving to subgrade levels.
 - .1 In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

3.4 FIELD QUALITY CONTROL

- .1 Testing of materials and compaction of backfill and fill will be carried out by testing laboratory designated by Departmental Representative.
-

- .2 Not later than 1 week minimum before backfilling or filling, submit to designated testing agency, samples of backfill as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Do not begin backfilling or filling operations until material has been approved for use by Departmental Representative.
- .4 Not later than 48 hours before backfilling or filling with approved material, notify Departmental Representative to allow compaction tests to be carried out by designated testing agency.

3.5 BACKFILLING

- .1 Inspection: do not commence backfilling until fill material and spaces to be filled have been inspected and approved by Departmental Representative.
- .2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.
- .3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures. Backfill simultaneously each side of walls and other structures greater than 1.3 m deep to equalize soil pressures.
- .4 Compaction of subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as fill.
 - .1 Fill excavated areas with selected subgrade material compacted as specified for fill.
- .5 Placing:
 - .1 Place backfill, fill and base course material in 300 mm lifts: add water as required to achieve specified density.
- .6 Compaction: compact each layer of material to following densities for material to ASTM D698:
 - .1 To underside of base courses: 95%.
 - .2 Base courses: 100%.
 - .3 Elsewhere: 90%.
- .7 Backfill against foundations, sign and flagpole foundations, catch basins, and maintenance holes with excavated material.
- .8 Place 150 mm compacted thickness of Granular A material below slab on grade, catch basins, and maintenance holes.
- .9 Place 250 mm compacted thickness of Granular B sub-base material for light duty areas and 400mm compact thickness of Granular B sub-base material for heavy duty areas. Place 150 mm compacted thickness of Granular A base material below asphalt paving.
- .10 Place 150 mm compacted thickness of Granular A material below ramp and walks.
- .11 Place 150 mm granular A bedding in trench to support services through their length. Following approval of service installation handfill with Granular A bedding to 300 mm compacted thickness over services. Backfill remainder of trench with excavated materials.
- .12 Place 150 mm compacted thickness of Granular A below concrete curbs.
- .13 Restore surface of excavation with material and finish to match existing adjoining surfaces.

- .14 Under slabs and paving:
 - .1 Use excavated materials up to bottom of granular base courses for paving and Granular B for building slab.
 - .2 Use Granular B for base courses.
- .15 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.
- .16 Blown rock material, not capable of fine grading, is not acceptable, imported material must be placed on this type of material
- .17 Against foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.
- .18 Underground tanks: use sand to bottom of granular base courses or to bottom of topsoil, as applicable.

3.6 GRADING

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by Departmental Representative.
 - .1 Grade to be gradual between finished spot elevations shown on drawings.
- .2 Strip topsoil as specified above over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil. Stockpile topsoil on site for later use.
- .3 Fill and grade site to achieve elevations indicated.
- .4 Place excavated material in 300 mm lifts.
- .5 Compact to 80% Standard Proctor Density.
- .6 Grade to a uniform slope with a tolerance of 1:120.

3.7 SHORTAGE AND SURPLUS

- .1 Supply necessary fill to meet backfilling and grading requirements and with minimum and maximum rough grade variance.
- .2 Dispose of surplus material off site.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Dispose of cleared and grubbed material off site daily.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
 - .3 Waste Management: separate waste materials for reuse, recycling and organics in accordance with Section 01 74 20.
-

3.9 PROCEDURE FOR REMOVING MATERIAL FROM THE INSTITUTION

- .1 Co-ordinate trips and counts to maximize efficiency of removal operations and minimize impact on CSC operations.
- .2 Trucks being loaded with soil will be supervised by CSC staff or Commissionaire. Trucks cannot be loaded without this supervision.
- .3 The loading supervisor will accompany the truck to the Service Entrance and inform the officer-in-charge of the Service Entrance of his presence during loading.
- .4 The truck will exit through the Service Entrance after being searched and processed.
- .5 Then it will be escorted by vehicle patrol to an area on site outside the security perimeter where the load will be dumped.
- .6 Contractor shall remove and dispose the material from the storage site at a later time.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

1.2 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than a specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- .3 Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than a specified depth below existing ground surface.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Samples:
 - .1 Submit 1 sample of each material listed below for approval prior to delivery of materials to project site.
 - .2 Tree wound paint: one liter can with manufacturer's label.
- .3 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- .2 Safety Requirements: worker protection.
 - .1 Workers must wear gloves, dust masks, long sleeved clothing, eye protection and protective clothing when applying herbicide materials.
 - .2 Workers must not eat, drink or smoke while applying herbicide material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill.

1.5 STORAGE AND PROTECTION

- .1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, and root systems of trees which are to remain.
 - .1 Repair any damaged items to approval of Departmental Representative.
-

- .2 Replace any trees designated to remain, if damaged, as directed by Departmental Representative.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Bituminous based paint of standard manufacture specially formulated for tree wounds.
- .2 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Remove and store soil material for reuse.

Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion controls found on the Site Grading Plan (C2.10).
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

- .1 Inspect site and verify with Departmental Representative, items designated to remain.
- .2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.
- .3 Notify utility authorities before starting clearing and grubbing.
- .4 Keep roads and walks free of dirt and debris.

3.3 APPLICATION

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

3.4 CLEARING

- .1 Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.
- .2 Clear as indicated on the Existing Conditions and Removals Plan (C1.10), by cutting at a height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.
- .3 Cut off branches overhanging area cleared as directed by Departmental Representative.
- .4 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.5 ISOLATED TREES

- .1 Cut off isolated trees as indicated on the Existing Conditions and Removals Plan (C1.10) at height of not more than 300 mm above ground surface.
- .2 Grub out isolated tree stumps.
- .3 Prune individual trees as indicated.
- .4 Trim trees designated to be left standing within cleared areas of dead branches 4 cm or more in diameter; and trim branches to heights as indicated.
- .5 Cut limbs and branches to be trimmed close to bole of tree or main branches.
- .6 Paint cuts more than 3cm in diameter with approved tree wound paint.

3.6 GRUBBING

- .1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 200 mm below ground surface.
- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.7 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials off site.
- .2 Remove diseased trees identified by Departmental Representative and dispose of this material to approval of Departmental Representative.

3.8 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for stripping of topsoil to approval of Departmental Representative.

3.9 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
-

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion controls indicated on the Site Grading Plan (C2.10).
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Ensure that procedures are conducted in accordance with applicable Provincial and Municipal requirements.
 - .2 Remove topsoil before any construction procedures commence to avoid compaction of topsoil.
 - .3 Handle topsoil only when it is dry and warm.
 - .4 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.
 - .5 Remove brush from targeted area by non-chemical means and dispose of through mulching.
 - .6 Strip topsoil to depths required to remove all topsoil. Avoid mixing topsoil with subsoil.
 - .7 Pile topsoil by mechanical hoe in berms in locations as directed by Departmental Representative. Stockpile height not to exceed 2.5 m.
 - .8 Dispose of unused topsoil off-site.
 - .9 Protect stockpiles from contamination and compaction.
-

- .10 Topsoil that has been piled for long term storage will be covered with trefoil or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

- .1 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
 - .1 Grade area only when soil is dry to lessen soil compaction.
 - .2 Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.4 PLACING OF TOPSOIL

- .1 Place topsoil only after Departmental Representative has accepted subgrade.
- .2 During dry conditions spread topsoil by mechanical hoe and/or dozer in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
- .3 Establish traffic patterns for equipment that will prevent driving on topsoil after it has been spread to avoid compaction.
- .4 Cultivate the soil following spreading procedures.

3.5 SUB-SOILING

- .1 Following the spreading and cultivating procedures sub-soil the area to improve drainage and agricultural potential of soil.
- .2 With a vibrating sub-soiler work the area to a depth of 40 cm. Follow the contour lines of the natural grades of the area.
- .3 Cross sub-soil the area following the first pass.
- .4 Cultivate the soil with a chain harrow to de-clod the soil.

3.6 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International (ASTM)
 - .1 ASTM D698-12, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Underwriters' Laboratories of Canada (ULC)

1.2 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is available as appendix document.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan, contractor must obtain locates to confirm.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Excavated or graded material existing on site suitable to use as fill for grading work if approved by Departmental Representative.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for rough grading 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

3.2 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Departmental Representative.
 - .2 Commence topsoil stripping of areas required to accommodate construction after area has been cleared of brush, weeds, and grasses and removed from site.
 - .3 Strip topsoil to depths required to remove all topsoil. Avoid mixing topsoil with subsoil.
 - .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2.5 m.
 - .5 Dispose of unused topsoil off site.
-

3.3 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to following depths below finish grades:
 - .1 150 mm for grassed areas.
 - .2 300 mm for flowerbeds.
 - .3 300 mm for shrub beds.
 - .4 490 mm for light duty asphalt paving.
 - .5 650mm for heavy duty asphalt paving.
 - .6 275 mm for concrete walks.
- .3 Slope rough grade away from building as indicated on the Site Grading Plan (C2.10).
- .4 Grade ditches to depth as indicated on the Site Grading Plan (C2.10).
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, as follows:
 - .1 85% under landscaped areas.
 - .2 95% under paved and walk areas.
- .7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.4 TESTING

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid by Departmental Representative in accordance with Sections 01 45 00.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect and or transplant existing fencing, trees, landscaping, surface or underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.
-

- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .6 ASTM D1557-09, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .7 ASTM D1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .8 ASTM D4318-10, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
- .4 Ontario Provincial Standard Specifications (OPSS)/Ontario Ministry of Transportation
 - .1 OPSS 1004 November 2006, Ontario Provincial Standard Specification, Material Specification for Aggregates - Miscellaneous.
 - .2 OPSS 1010 April 2004, Ontario Provincial Standard Specification, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Refer to OPSS 1010.
- .2 Granular sub-base material: in accordance with Section 31 00 00.01 and following requirements:

- .1 Crushed, pit run or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

- .3 Table

Sieve Designation	% Passing			
100 mm	-	-	-	-
75 mm	100	100	100	-
50 mm	-	-	-	100
37.5 mm	-	-	-	-
25 mm	55-100	-	-	60-100
19 mm	-	-	-	-
12.5 mm	-	-	-	38-70
9.5 mm	-	-	-	-
4.75 mm	25-100	25-85	-	22-55
2.00 mm	15-80	-	-	13-42
0.425 mm	4-50	5-30	0-30	5-28
0.180 mm	-	-	-	-
0.075 mm	0-8	0-10	0-8	2-10

- .4 Other properties as follows:
 - .1 Liquid Limit: to ASTM D4318, Maximum 25.
 - .2 Plasticity Index: to ASTM D4318, Maximum 6.
 - .3 Los Angeles degradation: to ASTM C131.
 - .1 Maximum loss by mass: 40 50 %.
 - .4 Particles smaller than 0.02 mm: to ASTM D422, Maximum 3%.
 - .5 Soaked CBR: to ASTM D1883, Minimum 40 when compacted to 100% of ASTM D1557.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for granular sub-base 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.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according sediment and erosion controls on the Site Grading Plan (C2.10).
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .2 Construct granular B sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Departmental Representative may authorize thicker lifts if specified compaction can be achieved.
- .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .7 Remove and replace portion of layer in which material has become segregated during spreading.

3.4 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 98% corrected maximum dry density in accordance with ASTM D698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 CLEANING

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

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.7 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D1557-09, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .6 ASTM D1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .7 ASTM D4318-10, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Ontario Provincial Standard Specifications (OPSS)/Ontario Ministry of Transportation
 - .1 OPSS 1004 November 2006, Ontario Provincial Standard Specification, Material Specification for Aggregates - Miscellaneous.
 - .2 OPSS 1010 April 2004, Ontario Provincial Standard Specification, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

1.2 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver and stockpile aggregates in accordance with Section 31 00 00.01. Stockpile minimum 50% of total aggregate required prior to beginning operation.
- .2 Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused granular material from landfill to local quarry as approved by Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Granular base: material in accordance with Section OPSS 1010 Granular A and following requirements:

.1 Crushed stone or gravel.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

.1 Gradation Method # 1 to:

Sieve Designation	% Passing		
	(1)	(2)	(3)
100 mm	-	-	-
75 mm	-	-	-
50 mm	100	-	-
37.5 mm	70-100	-	-
25 mm	-	100	-
19 mm	50-75	-	100
12.5 mm	-	65-100	70-100
9.5 mm	40-65	-	-
4.75 mm	30-50	35-60	40-70
2.00 mm	-	22-45	23-50
0.425 mm	10-30	10-25	7-25
0.180 mm	-	-	-
0.075 mm	3-8	3-8	3-8

.2 Gradation Method #2 to: insert name of agency and material type except that percentage finer than 0.075 mm not to exceed 8%.

.3 Material to level surface depressions to meet gradation (2) limits in accordance with Method #1.

.4 Liquid limit: to ASTM D4318, maximum 25.

.5 Plasticity index: to ASTM D4318, maximum 6.

.6 Los Angeles degradation: to ASTM C131. Max. % loss by weight: 45.

.7 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C136.

<u>Passing</u>		<u>Retained on</u>
50 mm	to	25 mm
25 mm	to	19.0 mm
19.0 mm	to	4.75 mm

.8 Soaked CBR: to ASTM D1883, min 80 100, when compacted to 100% of ASTM D1557.

Part 3 EXECUTION

3.1 SEQUENCE OF OPERATION

- .1 Place granular base after sub-base surface is inspected and approved by Departmental Representative.
- .2 Placing
 - .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .6 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment
 - .1 Compaction equipment to be capable of obtaining required material densities.
- .4 Compacting
 - .1 Compact to density not less than 100% corrected maximum dry density in accordance with ASTM D698.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.3 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D242-04, Mineral Filler for Bituminous Paving Mixtures
 - .2 ASTM D692-99 (2004), Course Aggregate for Bituminous Paving Mixtures
 - .3 ASTM D946-82(1999), Penetration-Graded Asphalt Cement for Use in Pavement Construction
 - .4 ASTM D979-01, Sampling Bituminous Paving Mixtures
 - .5 ASTM D995-95b(2002), Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
 - .6 ASTM D1073-01, Fine Aggregate for Bituminous Paving Mixtures
 - .7 ASTM D5581-96(2001) Standard Test Method for Resistance To Plastic Flow Of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
 - .8 ASTM D2027-97(2004), Cutback Asphalt (Medium-Curing Type)
 - .9 ASTM D3515-01, Hot-Mixed, Hot -Laid Bituminous Paving Mixtures
- .2 Asphalt Institute:
 - .1 Asphalt Institute IS-91, Full-Depth Asphalt Pavements for Parking Lots, Service Stations and Driveways
 - .2 Asphalt Institute MS-4, The Asphalt Handbook
 - .3 Asphalt Institute SS-1, Model Construction Specifications for Asphalt Concrete
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric
 - .2 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes
 - .3 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes
 - .4 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes
 - .5 CAN/CGSB 1.5-M-91, Low Flash Petroleum Spirits Thinner
 - .6 CGSB-1.74-2001, Alkyd Traffic Paint
- .4 Ontario Provincial Standards for Roads & Public Works (OPSS):
 - .1 OPSS 310, Construction Specifications for Hot Mix Asphalt
 - .2 OPSS 1150, Material Specification for Hot Mix Asphalt (HMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175°C 4 weeks prior to beginning Work.
- .3 Samples:
 - .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks prior to beginning Work.
 - .2 Submit samples of following materials proposed for use 4 weeks prior to beginning Work.
 - .1 One 5 L container of asphalt cement.
 - .2 1 kg of hydrated lime.
- .4 Test and Evaluation Reports:
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
 - .2 Submit manufacturer's test data and certification that hydrated lime meets specified requirements.
 - .3 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 4 weeks prior to beginning Work.
 - .4 Submit printed record of mix temperatures at end of each week.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Deliver and stockpile aggregates in accordance with erosion and sedimentation control plan. Stockpile minimum 50% of total amount of aggregate required before beginning asphalt mixing operation.
 - .3 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
 - .4 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
 - .5 Provide approved storage, heating tanks and pumping facilities for asphalt cement.
 - .6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
-

Part 2 PRODUCTS

2.1 HOT-MIX, HOT-LAID ASPHALT (HMA)

- .1 The materials used in the production of the HMA shall be according to OPSS 1150 for marshall mix designs, and the following requirements.

2.2 BITUMINOUS MATERIALS

- .1 Asphalt Cement:
 - .1 Parking Areas: Penetration grade of 200 – 300 in accordance with to ASTM D946.
 - .2 Aggregates shall be coated with a minimum film thickness of 6.5 µm in accordance with Marshall Mix Design Criteria and requirements of ASTM D5581.
- .2 Tack Coat: Emulsified anionic asphalt, SS-1 or SS-1h mixed with water and meeting the requirements of ASTM D977.
- .3 Primer Coat: medium curing, medium viscosity cutback asphalt, MC-80 meeting the requirements of AASHTO M82 and ASTM D2027.

2.3 MINERAL AGGREGATE

- .1 Mineral aggregate for asphalt plant-mix shall consist of crushed stone, crushed gravel, sand, mineral filler, to ASTM D692 and ASTM D1073 and mineral filler. Mineral filler may be portland cement, pozzolan, or commercially ground stone dust conforming to ASTM D242, and as follows:
 - .1 Coarse aggregate shall be sound, angular crushed stone, crushed gravel, or crushed slag. Uncrushed coarse aggregate may be used in base course mixtures if the mixture meets all design criteria. The fine aggregate shall be well graded, moderately sharp to sharp sands.
 - .2 Mineral aggregate and asphalt shall be combined in a mixing plant to meet the following nominal gradations for asphalt concrete specified in Table 2: Gradation Requirements Mix Design Criteria in OPSS 1150.

2.4 ACCESSORIES

- .1 Line and symbol Paint:
 - .1 To CGSB 1-GP-74M, alkyd traffic paint;
 - .1 Colour: To be selected by Departmental Representative
 - .2 Thinner: To CAN/CGSB-1.5.
- .2 Adjustment Rims: as required to adjust elevation of manhole rims and valve chambers.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Grades and elevations shall be laid out as indicated on Drawings, and as follows:
 - .1 Set grade stakes to the correct elevation.

- .2 Coordinate grades with existing features and adjoining properties to ensure proper drainage.
- .2 Remove all debris, vegetation, and other deleterious materials from the site, except for trees or shrubs designated for preservation.
- .3 Grade site in accordance with Section 31 05 00 to the required profiles and remove excess material removed from site.
- .4 Compact subgrade at the lowest moisture content such that firm closing of hand can mould a handful of soil:
 - .1 Surface of subgrade after compaction: Hard, uniform, smooth, and true to grade and cross-section.
 - .2 Confirm compaction by driving a heavily loaded truck over subgrade and verify that minimal deflection occurred.
 - .3 Roll subgrade to correct conditions where significant deflection occurs.
 - .4 Scarify subgrade to a depth of 150 mm (6") and re-compact where rolling does not correct the soft condition.
 - .5 Remove and replace subgrade with select materials where re-compactation does not correct soft condition.
- .5 Treat subgrade with a soil sterilant at the rate specified by the manufacturer to prevent the growth of weeds prior to placing base courses.
- .6 Prepare granular base courses in accordance with Section 31 05 00.
- .7 Apply cutback asphalt prime coat to prepared granular base courses at a minimum rate of 0.7 L/m² (0.15 gal/yd²).
- .8 Patch and repair existing soft spots, aligating, and bird-baths in existing asphalt concrete surfaces ready for application of new surface sheet:
 - .1 Apply emulsified asphalt tack coat to prepared existing asphalt surfaces at a rate of 0.25 L/m² (0.05 to 0.15 gal/yd²).
 - .2 Dilute asphalt emulsion with equal parts of water.

3.2 PAVEMENT CONSTRUCTION

- .1 Light Traffic Construction: Lay plant hot-mixed, hot laid asphalt on prepared subgrade and base courses to a total thickness of 80 mm (40 mm HL8, 40 mm HL3).
 - .1 Asphalt to be laid to a compacted thickness of 40 mm.
- .2 Heavy Traffic Construction: Lay plant hot-mixed, hot laid asphalt on prepared subgrade and base courses to a total thickness of 120 mm (80 mm HL8, 40 mm HL3).
 - .1 Asphalt to be laid to a compacted thickness of 40 mm.
- .3 Spreading Base and Surface Courses:
 - .1 For areas greater than 840 m² (1,000 yd²):
 - .1 Spread asphalt base and surface courses and strike off with a paver.
 - .2 Any irregularities in the surface of the pavement course shall be corrected directly behind the paver.
 - .3 Remove excess material forming high spots with a shovel or a lute.

- .4 Fill indented areas with hot mix and smoothed with a lute or the edge of a shovel being pulled over the surface.
- .5 Not Permitted: Casting of mix over such areas.
- .2 For areas less than 840 m² (1,000 yd²) and in areas where it is not practical to use a paver or spreader box:
 - .1 Spread asphalt base and finish surface courses by hand.
 - .2 Use rigidly supported wood or steel forms to ensure correct grade and cross-section.
 - .3 Placing by hand shall be performed carefully to avoid segregation of the mix.
 - .4 Not Permitted: Broadcasting of the material.
 - .5 Remove lumps that do not break down readily.
- .4 Roll and compact hot-mix material immediately without displacement; continue rolling until thoroughly compacted and all roller marks have disappeared.
- .5 Use a vibrating plate compactor or hand tamper in areas too small for the roller to achieve thorough compaction.
- .6 Surface of completed work shall be level to 6 mm (1/4") in 3 m (10') when tested with a straightedge. Surface shall not contain irregularities that affect drainage, create puddles created than 0.2 m² (2 ft²).
- .7 Profile surfaces to a minimum slope of 20 mm (3/4") in 1 m (40") towards drains, drop paving at drain locations to prevent standing water. Slopes shall not exceed 32 mm (1 1/4") in 1 m (40").

3.3 APPLICATION OF PAVEMENT LINE MARKINGS

- .1 Prepare pavement surface in accordance with paint manufacturer's written instructions.
- .2 Paint lines straight and in uniform width, at locations indicated on drawings.
- .3 Paint accessible parking symbols as indicated on drawings.
- .4 Apply paint using marking machine or line stencil, and as recommended by manufacturer, to minimum 0.18 mm dry film thickness.
- .5 Line Width at Roadways and Parking Areas: 150 mm, except where otherwise indicated.

3.4 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.
 - .1 If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for sand-set unit paving without mortared joints for pedestrian or light vehicular traffic.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C117-95, Standard Test Method for Material Finer Than 75- μ m (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m^{3 - .4 ASTM D1557-07, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700kN-m/m^{3 - .5 ASTM E11-01, Standard Specification for Wire-Cloth Sieves for Testing Purposes.}}
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.3 SUBMITTALS

- .1 Submit following product test data:
 - .1 Sieve analysis for gradation of bedding and joint material.
 - .2 Unit paver test data.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Indicate layout, pattern and relationship of paving joints to fixtures and project formed details.
- .4 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Unit pavers: uniform in material, colour, size and from one manufacturer.
 - .2 Precast concrete paving slabs: to CSA-A231.1, exposed aggregate face, exposed aggregate type, 100 mm x 200 mm paver size, 70 mm thick. Colour as selected from standard range.
 - .3 Crushed stone or gravel base: consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
-

- .1 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

<u>Sieve Designation</u>	<u>% Passing</u>
19 mm	100
12.5 mm	70-100
4.75 mm	40- 70
2.00 mm	23- 50
0.425 mm	7- 25
<u>0.075 mm</u>	<u>3- 8</u>

- .4 Manufactured sand for bedding: hard, durable, crushed stone particles, conforming to gradation of concrete sand as specified in CAN/CSA A23.1. Sand: free from clay lumps, cementation, organic material, frozen material and other deleterious materials. Do not use limestone screenings or stone dust.

- .1 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 0% to pass 0.075 mm sieve.

<u>Sieve Designation</u>	<u>% Passing</u>
10 mm	100
5 mm	95-100
2.5 mm	80-100
1.25 mm	50- 90
0.630 mm	25- 60
0.315 mm	10- 35
<u>0.160 mm</u>	<u>2- 10</u>

- .5 Joint sand: to CSA A179, hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .6 Filter Fabric: Manufacturer's standard non-woven polypropylene fabric, needled punched, UV stabilized for plaza deck applications; having elongation greater than 50%

Part 3 EXECUTION

3.1 PROTECTION

- .1 Prevent damage to buildings, landscaping and adjacent property. Make good any damage.
- .2 Provide access to building at all times. Coordinate paving schedule to minimize interference with normal use of premises.

3.2 SUBGRADE

- .1 Ensure that subgrade preparation conforms to levels and compaction required to allow for installation of granular base.

3.3 GEOTEXTILE

- .1 Install geotextile filter as indicated.

3.4 GRANULAR BASE

- .1 Base minimum thickness: as indicated and in accordance with Manufacturer's written instructions.

- .2 Spread and compact crushed stone or gravel base in uniform layers not exceeding 100 mm compacted thickness.
- .3 Compact base to a Standard Density in accordance with ASTM D698.
- .4 Shape and roll alternately to obtain smooth, even and uniformly compacted granular base and ensure conformity of grades with finish surface.
- .5 Apply water as necessary during compaction to obtain specified density. If granular base is excessively moist, remove it and install more granular material to rid it of sponginess.
- .6 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.5 BEDDING SAND

- .1 Use material other than bedding sand to compensate for depressions that exceed specified tolerances in surface of base.
- .2 Do not use joint sand for bedding sand.

3.6 SURFACE COURSE

- .1 Ensure bedding sand and granular base are not saturated prior to placement of unit pavers.
- .2 Install unit paving true to grade on the bedding sand, in location, layout and pattern as indicated.
- .3 Where required, cut units accurately without damaging edges.
- .1 Overall dimensions may be adjusted slightly to conform with paver modules and reduce cutting upon approval by the Consultant.
- .2 Prior to placement of levelling bed, place filter cloth at drain locations.
- .3 Place bedding course only for pavers that will be laid in same day. Ensure that bed is not disturbed by foot or other causes. Do not lay pavers on frozen or otherwise disturbed base course.
- .4 Install pavers true to line and level. Set pavers snugly together with minimum joint width. Blend smoothly with adjacent grades.
- .5 Where necessary, cut stone pavers with a power driven masonry saw to produce a true, even and undamaged edge. Cut pavers of less than 50 mm dimension or guillotine cut pavers will not be accepted.
- .6 Sweep joint filler into joints and make second pass with vibrator.
- .7 Wash in with light spray of water to ensure joints are completely filled.
- .8 Wash and sweep pavers clean.
- .9 After installation check grade with straight edge and remove any imperfections exceeding 3 mm per 3 metres.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A121-07, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 1-GP-178Ma, Primer, Zinc Dust/Zinc Oxide, Alkyd (For Galvanized Surfaces).
 - .2 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .3 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .4 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
- .3 CSA International
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit shop drawings for each type locking device to show fabrication, layout, setting and erection details.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect fence and gate materials from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Design wind pressures:
 - .1 Line posts: 874 Pa.

2.2 MATERIALS

- .1 Concrete mixes and materials: in accordance with CSA A23.1/A23.2.
 - .1 Compressive strength: 25 MPa at 28 days.
 - .2 Exposure classification: F-1.
 - .3 Slump: 80 mm at time of deposit +/-30 mm.
 - .4 Air entrainment: 6%.
 - .5 Aggregate size: 38 mm maximum, 9.5 mm minimum.
- .2 Fabric: to CAN/CGSB-138.1, galvanized, Table 1.
 - .1 Fabric Type 1, Class A, Style 1-heavy.
 - .2 Height of fabric: as indicated.
 - .3 Wire Size: 4.8mm (min) (6 Gauge).
 - .4 Size of mesh: 50.8mm.
 - .5 Twisted selvage top and bottom.
 - .6 Average mass of zinc coating to be not less than 610g/m² of uncoated wire.
- .3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe.
 - .1 Post Type 1 hot-rolled, butt or electrical resistance welded, dimensions to Table 2, Style A heavy. Minimum yield strength: Type 1, 170 MPa.
 - .2 Rail Type 2, Style A Heavy, dimensions to Table 3, minimum yield strength 344 MPa.
 - .3 Corner posts = 150 mm OD, 21 kg/m.
 - .4 Line Posts = 73 mm OD, 8.6 kg/m.
 - .5 Top and bottom rails and braces = 42.2 mm, 3.4 kg/m.
- .4 Tie wire fasteners: single strand, galvanized, 3.7 mm diameter.
- .5 Bottom tension bar: 5 x 20 mm minimum galvanized steel.
- .6 Tension bar bands: 3 x 20 mm minimum galvanized steel.
- .7 Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
- .8 Zinc rich paint: to CGSB 1-GP-178Ma.
- .9 Barbed wire: 2 mm diameter, galvanized steel wire to ASTM A121, 4 point barbs 125 mm spacing.
- .10 Barbed tape concertina:
 - .1 Galvanized steel barbed tape 20 x 0.5 mm
 - .2 Barbs 20 mm long, 45 mm o.c.
 - .3 Core wire 2.5 mm diameter high tensile spring steel, galvanized.
 - .4 Barbed tape cold-clenched over core wire.

- .5 Coil diameter 710 mm.
- .11 Bands: aluminum 6 x 25 mm self-locking, offset and centered type as required.
- .12 Clips: galvanized sheet metal, 3.8 mm.
- .13 Overhang tops: galvanized malleable iron with eyes to hold top rails and v-shaped projections to hold barbed wire overhang. Provide projection with clips or recesses to hold 6 strands of barbed wire as indicated on drawings spaced 100 mm apart. Projection of legs approximately 800 mm long to project from fence at 30° above horizontal.

2.3 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.
 - .2 For pipe: to CAN/CGSB-138.2
 - .3 For barbed wire: to ASTM A121, Class 2.
 - .4 For other fittings: to CAN/CSA-G164-M92(R2003).

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate 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.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Grading: Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface centre of bottom rail and ground of 50 mm.

3.3 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and to CAN/CGSB-138.3.
- .2 Drill post holes to dimensions and depth shown on Drawings.
- .3 Space line posts maximum 2.5 m apart, measured parallel to ground surface.
- .4 Install corner post where change in alignment exceeds 20 degrees.
- .5 Install end posts at end of fence, refer to drawings for details.
- .6 Place concrete in post holes then embed posts into concrete. Extend concrete 50 mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .7 Do not install fence fabric until concrete has cured a minimum of 5 days.
- .8 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.
 - .1 Install braces on both sides of corner and straining posts in similar manner.
- .9 Install top and bottom rail between posts and fasten securely to posts with waterproof caps.
- .10 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.
 - .1 Knuckled selvedge at bottom.
 - .2 Twisted selvedge at top.
- .11 Secure fabric to top rails, line posts and bottom rail with tie wires at 300 mm intervals. Give tie wires minimum two twists.
- .12 Secure bottom rail to ground barrier with galvanized anchor clamp.
- .13 Stretch 6 strands of barbed wire taut over extension arms with top strand 305 mm above fabric, secure to end and gate posts with bands. Install barbed wire strands and clip securely to lugs of each projection.
- .14 Secure barbed tape concertina to barbed wire with wire ties at 130 mm spacing, maximum tape separation 230 mm.
- .15 Install grounding rods as indicated.

3.4 INSTALLATION OF GATES

- .1 Install gates in locations as indicated and where directed by Departmental Representative.
- .2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.

3.5 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas as indicated.
 - .1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.6 GROUNDING

- .1 Install grounding rods as indicated or directed.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
 - .1 Clean and trim areas disturbed by operations. Dispose of surplus excavated material and replace damaged sod.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 CONFORMANCE

- .1 The General Conditions are part of this Section and shall apply as if written herein.

1.2 SCOPE OF WORK

- .1 Placement and grading of imported topsoil to levels and dimensions as per drawings or instructions of Departmental Representative.
- .2 Placing and grading of topsoil produced from stripping of existing soil to levels and dimensions as per drawings or instructions of Departmental Representative.

1.3 SUBMITTALS

- .1 Submit in accordance with section 01 33 00 – Submittal Procedures.
- .2 Submit two (2) copies of soil analysis and recommendations for corrections to Departmental Representative.

1.4 SCHEDULING

- .1 Schedule placing of topsoil to permit sodding and planting operations under optimum conditions.

1.5 PROTECTION

- .1 Prevent damage to fencing, railing, posts, trees, landscaping, bench marks, existing pavement and surface or underground utility lines which are to remain. Make good any damage.

Part 2 Product

2.1 SOURCE QUALITY CONTROL

- .1 Acceptance of imported topsoil subject to inspection and soil analysis test results. Do not commence work until topsoil accepted by Departmental Representative.
 - .2 Inspection and testing of topsoil to be carried out by approved testing laboratory.
 - .3 Test topsoil from source prior to stockpiling, for clay, sand and silt, percentage and particle size, dry density, NPK, Mg, soluble salt content, pH value, growth inhibitors, soil sterilants, organic material, trace elements.
 - .1 Use 25mm diameter sampling tube or spade and in presence of Departmental Representatives take 20 samples from topsoil stockpile at random locations. Mix samples together thoroughly before submitting for testing.
 - .2 Submit .5 kg. sample of topsoil to testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship sample in accordance with provincial regulations and testing laboratory requirements.
 - .3 Determine required limestone treatment to bring pH level of soil to 6-7.
-

2.2 MATERIALS

- .1 Topsoil: All topsoil used for planting purposes shall be screened, fertile, friable, natural loam containing four percent (4%) minimum organic matter for clay loams and two percent (2%) minimum organic matter for sandy loams. Acidity of topsoil shall range from 6.0pH to 7.5 pH (levels of NPK and Mg are to be noted). It shall be free of any mixture of subsoil, clay lumps, stones, and roots over 50mm in diameter and any toxic materials or foreign objects and shall be reasonably free of weed and weed seeds.
- .2 Loam: Sandy loam topsoil.
- .3 Compost: Processed organic matter containing 40% or more organic matter as determined by the Walkley-black or LOI test. Decayed leaf or mushroom compost as available by Gro Bark, All Treat Farms or Grower's Choice or approved equal. Compost shall be free of metals and glass or other unacceptable materials for planting use. Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth.
- .4 Manure: Well-rotted, unbleached cattle manure; free from harmful chemicals and other injurious substances, and sawdust, shavings or similar refuse; at least eight (8) months old, but not more than two (2) year old; and with no more that 25% straw, leaves, or other unacceptable materials for planting use.
- .5 Pine Bark Compost: Decomposed pine bark mulch with or without Perlite as available from Gro Bark, All Treat Farms or Grower's Choice or approved equal.
- .6 Pine Bark Mulch: Finely Shredded Pine bark mulch as available from Gro Bark, All Treat Farms or Grower's Choice or approved equal.
- .7 Peatmoss: Derived from partially decomposed sphagnum mosses; brown in colour, elastic and homogeneous with shredded particle sizes of minimum 5mm, free of wood and deleterious material which could prohibit plant growth.
- .8 Bonemeal: Raw, commercial, finely ground and with a minimum content of 4% nitrogen and 20% phosphoric acid.
- .9 Fertilizer:
 - .1 Complete commercial fertilizer, 50% of the elements of which shall be derived from organic sources, and containing no less than 60% urea-formaldehyde with percentages by weight of nitrogen, phosphoric acid, and potash required to make up chemical deficiencies of soil and as required by plant growth and noted in soil test results.
 - .2 Incorporate finely ground commercial superphosphate with a minimum analysis of 20% phosphorous (v) oxide.
 - .3 Acid Fertilizer 15-5-10, pH level 5.5 – 6.5.

Part 3 Execution

3.1 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct. If discrepancies occur, notify the Departmental Representative and do not commence work until instructed by the Departmental Representative.
-

- .2 Fine grade soil, eliminating uneven areas and low spots, ensuring positive drainage. Remove soil contaminated with toxic materials such as calcium chloride, toxic materials or petroleum products. Dispose of removed materials off site or as directed by Departmental Representative.
- .3 Cross-Cultivate entire areas that are to receive topsoil to depth of 100mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.
- .4 Remove surface debris, roots, vegetation branches and stones in excess of 25mm diameter.

3.2 SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Spread topsoil after Departmental Representative has inspected and approved the subgrade.
- .2 Spread topsoil with adequate moisture in uniform layers not exceeding 150mm over approved, unfrozen subgrade, where sodding and planting indicated. Be aware of special topsoil make-up for tree pits in concrete paving.
- .3 For sodded areas keep topsoil 15mm below finished grade.
- .4 Apply topsoil as indicated to following minimum depths after settlement:
 - .1 100mm for sodded and seeded areas
 - .2 400mm for planting beds
- .5 Manually spread topsoil around trees, shrubs, and other obstacles.
- .6 The specified depth of topsoil shall be measured and approved by the Departmental Representative after settlement and consolidation as specified.

3.3 SOIL AMENDMENTS

- .1 Apply soil amendments at rate as specified and as determined from soil sample test.
- .2 Mix soil amendments into full depth of topsoil prior to application of fertilizer.

3.4 APPLICATION OF FERTILIZER

- .1 Apply fertilizer at least one (1) week after limestone application.
- .2 Spread fertilizer uniformly over entire area of topsoil at manufacturer's recommendation rate of application.
- .3 Mix fertilizer thoroughly to full depth of topsoil.

3.5 FINE GRADING

- .1 Fine grade topsoil eliminating rough and low areas to ensure positive drainage and meet the lines and levels indicated. Do all fine grading with approved equipment being careful not to excessively compact topsoil and by hand around plant material.
 - .2 Collect and dispose of stones over 150mm, debris, weeds and roots.
 - .3 Consolidate topsoil to required bulk density using equipment approved by the Departmental Representative. Leave surfaces smooth, uniform and firm against deep foot-printing.
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3.6 ACCEPTANCE

- .1 The Departmental Representative will inspect topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.7 SURPLUS MATERIAL

- .1 Dispose of excess or surplus material off site.

END OF SECTION

Part 1 General

1.1 GENERAL INSTRUCTIONS

- .1 The General Conditions, Supplementary Conditions and the Requirements of Division 01, are part of this Section and shall apply as if written here.

1.2 SOURCE QUALITY CONTROL

- .1 Obtain approval of sod at source from Departmental Representative.
- .2 When proposed source of sod is approved, use no other source without written authorization.

1.3 DELIVERY AND STORAGE

- .1 Schedule deliveries in order to keep storage at job site to minimum without causing delays.
- .2 Deliver, unload and store sod on pallets.
- .3 Deliver sod to site within 24 hours of being lifted and lay sod within 36 hours of being lifted.
- .4 Do not deliver small, irregular or broken pieces of sod.
- .5 During wet weather allow sod to dry sufficiently to prevent tearing during lifting and handling.
- .6 During dry weather protect sod from drying and water sod as necessary to ensure its vitality. Dry sod will be rejected.

1.4 SCHEDULING

- .1 Schedule sod laying to coincide with completion of topsoil placement operations.

Part 2 Product

2.1 MATERIALS

- .1 Nursery sod: Quality and source to comply with standards outlined in the latest issue of the Nursery Sod Growers Association of Ontario.
 - .2 Sod mixture:
 - .1 No. 2 (for area disturbed by construction) – Mixture of
 - .1 minimum 40% Kentucky Bluegrass and
 - .2 minimum 30% Creeping Red Fescue
 - .3 Broken, dry, discoloured` pieces will be rejected by Departmental Representative
 - .4 Wooden pegs, (17 x 17 x 200mm) or approved 200mm long steel staples.
 - .5 Water: potable.
 - .6 Fertilizer: complete organic slow release fertilizer with maximum 35% water soluble nitrogen
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- .7 Herbicide: type, rate and method of application subject to approval by Departmental Representative.

Part 3 Execution

3.1 LAYING OF SOD

- .1 Prior to sodding, obtain approval from Departmental Representative that finished grade and depth of topsoil are satisfactory.
- .2 Lay sod within 36 hours of being lifted.
- .3 Sodding during excessively wet conditions, at freezing temperature or over frozen soil is not acceptable.
- .4 Lay sod in rows, perpendicular to slope, and with joints staggered. Butt sections with sharp implements.
- .5 Where slope conditions exceed 3:1 slope then secure sod with wooden pegs. Place pegs 3 per square metre, 100 mm below top edge to prevent shifting of sod and drive pegs flush with top of sod soil. In sodded drainage swale use 6 pegs around entire edge of each square metre of sod.
- .6 Provide close contact between sod and soil with a light power roller providing a maximum weight of 680 kg/sq. metre. Use of heavy roller to correct irregularities in grade is not permitted.

3.2 MAINTENANCE

- .1 Maintain sodded area from start of installation until final acceptance.
- .2 Water sodded areas in sufficient quantities and at frequency required to maintain soil under sod continuously moist to depth of (75 to 100) mm.
- .3 Grass clippings on adjacent sidewalks or other paved areas must be cleaned up after mowing and trimming. Grass clippings are not to be blown on adjacent areas. If grass clippings are highly visible on the turf surface, turf should be mowed again to further mulch clippings. Excessive clippings are to be removed as directed by the Departmental Representative.
- .4 Maintain sodded area weed free.
- .5 Fertilize sodded areas one month after sodding with 2:1:1 ratio fertilizer. Spread evenly at rate of 0.5 kg of nitrogen/100 M2 and water in well.
- .6 Repair and renovate areas of poor drainage as directed by Departmental Representative.
 - .1 Remove sod and topsoil from areas requiring regrading to new elevations with sub grade 150 mm below final grade.
 - .2 Remove excess material from site or supply and spread fill to bring subgrade to required elevations.
 - .3 After regrading sub grade, supply and spread topsoil to depth of 150 minimum.
- .7 Repair and renovate areas of poor sod as directed by Departmental Representative.

- .1 Remove existing and dead sod, weeds and debris from area to be resodded. Loosen top layer by disking or roto-tilling. Prepare smooth loose surface for laying sod.
- .2 Apply fertilizer based on soil analysis. Rake into top layer of soil.
- .3 Use sod with grass mixture equivalent to one growing on site. If correct mixture is not known, use only sod that in appearance, equals existing lawn.
- .4 Lay sod with sections closely butted, without overlapping of gaps, smooth and even with adjoining areas. Stagger sod joints when sodding large areas. Roll lightly and tamp.
- .5 Water to obtain moisture penetration of 75 to 100 mm. Continue watering at intervals to maintain sufficient growth.
- .6 Maintain grass height at 50 mm in Spring and Fall. July and August mow height to be 60 mm

3.3 ACCEPTANCE

- .1 Sodded areas will be accepted at final inspection provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots and without weeds.
 - .3 No surface soil is visible when grass has been cut to height of 40 mm.
 - .4 Sodded areas have been cut minimum 2 times.
 - .5 Steel staples are to be removed after sod established and with approval by Departmental Representative.
 - .6 Sodded areas accepted at substantial performance may require mechanical aeration and topdressing at the discretion of the Departmental Representative. The Departmental Representative shall authorize and pay costs associated with aeration and topdressing works.
- .2 Lawns sodded in fall will be accepted in the following spring one month after start of growing season provided acceptance conditions are fulfilled.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes:
 - .1 Materials and installation for plant material, accessories, mulch, planting, tree support, mulching and maintenance.

1.2 RELATED SECTIONS:

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 32 91 21 – Topsoil Placement & Finish Grading

1.3 REFERENCES

- .1 Agriculture and Agri-Food Canada (AAFC).
 - .1 Plant Hardiness Zones in Canada-2000.
- .2 Canadian Nursery Landscape Association (CNLA).
 - .1 Canadian Standards for Nursery Stock 8th Edition.

1.4 DEFINITIONS

- .1 Mycorrhiza: association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

1.5 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for:
 - .1 Fertilizer.
 - .2 Mycorrhiza.
 - .3 Anti-desiccant.
 - .4 Guying assembly including clamps, collar, guying wire, anchors and wire tightener.
 - .5 Mulch.
- .3 Submit samples for:
 - .1 Mulch.
 - .2 Mycorrhiza.

1.6 SOURCE QUALITY CONTROL

- .1 Supply and deliver Products such as fertilizer and mulches, in standard containers clearly indicating contents, weight, analysis and name of manufacturer. If products are supplied in bulk, submit written statements indicating above information.
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- .2 Make all material available for inspection at source of supply and notify Departmental Representative at least seven days in advance of shipment. No work in this section is to proceed without approval.
- .3 Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.
- .4 Plant Material: True to genus, species and variety having normal growth habit; structurally sound, well branched, healthy densely foliated when in leaf and with healthy and well developed root system.
- .5 Supply and deliver Products such as fertilizer and mulches, in standard containers clearly indicating contents, weight, analysis and name of manufacturer. If products are supplied in bulk, submit written statements indicating above information.
- .6 Imported plant material must be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations. Submit inspection certificates as required from Federal, provincial and/or other regulatory agency.
- .7 Do not substitute plants without written submitted proof that specified plants or sizes are unobtainable.
- .8 Do not remove labels from plants until plants have been inspected and approved by the Departmental Representative.
- .9 Conform to Horticultural standards of the Canadian Nursery Trades Association with respect to grading and quality. Supply in accordance to the plant list.
- .10 Coordinate shipping of plants and excavation of holes to ensure minimum time laps between digging and planting.

1.7 STORAGE AND PROTECTION

- .1 Protect plant material from frost, excessive heat, wind and sun during delivery.
- .2 Immediately store and protect plant material that will not be installed within 1 hour after arrival at site in storage location approved by Departmental Representative.
- .3 Protect plant material from damage during transportation:
 - .1 When delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
 - .2 When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
 - .3 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
- .4 Protect stored plant material from frost, wind and sun and as follows:
 - .1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in sand or topsoil and watering to full depth of root zone.
 - .2 For pots and containers, maintain moisture level in containers.
 - .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.
 - .4 For aquatic plants, keep plants moist and do not allow to dry out between time of delivery to site and installation.

- .5 Store and manage hazardous materials in accordance with Section 01 45 16.19 – Site Quality Control Procedures: Waste Management During Construction.
- .6 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and/or recycling.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal: paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and/or recycling and place in designated containers for 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 National, Provincial, Regional and Municipal regulations.
 - .7 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
 - .8 Fold up metal and plastic banding, flatten and place in designated area for recycling.
 - .9 Divert discarded plastic plant containers materials from landfill to plastic recycling facility approved by Departmental Representative.
 - .10 Dispose of unused fertilizer at official hazardous material collection site approved by Departmental Representative.
 - .11 Dispose of unused anti-desiccant at official hazardous material collections site approved by Departmental Representative.
 - .12 Divert unused wood and mulch materials from landfill to appropriate recycling or composting facility as approved by Departmental Representative.

1.8 SCHEDULING

- .1 Obtain approval from Departmental Representative of schedule 7 days in advance of shipment of plant material.
- .2 Schedule to include:
 - .1 Quantity and type of plant material.
 - .2 Shipping dates.
 - .3 Arrival dates on site.
 - .4 Planting Dates.

1.9 MAINTENANCE PERIOD

- .1 Commence landscape maintenance immediately following installation of plant material.
 - .2 The Contractor to be responsible for the scheduled maintenance of plant, shrub, sod, and seed areas from the date of planting installation until Departmental Representative has fully occupied the facility.
 - .3 Perform maintenance work during regular working hours of 07:00 to 18:00, Monday to Friday.
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1.10 WARRANTY & ACCEPTANCE

- .1 The CONTRACTOR hereby warrants that the WORK shall be completed in a timely fashion, and in a good workmanlike and tidy manner, and guarantee the work against all defects in workmanship, materials, and against death of plant materials for a period of two years following issuance of Preliminary Acceptance Certificate. Any defects arising during the said period shall be remedied forthwith by the CONTRACTOR to the satisfaction of the Departmental Representative. At the request of the DEPARTMENTAL REPRESENTATIVE, the CONTRACTOR will assign to the DEPARTMENTAL REPRESENTATIVE or enforce on behalf of the DEPARTMENTAL REPRESENTATIVE all guarantees obtained by the CONTRACTOR with respect to the work.
- .2 The final date for Preliminary Acceptance in each calendar year is October 31. If the CONTRACTOR is unable to complete the work by that date, Preliminary Acceptance will not be scheduled until the spring of the following year and the two (2) year warranty will not commence until Preliminary Acceptance has been received. The CONTRACTOR will maintain the work until that time at no extra cost to the DEPARTMENTAL REPRESENTATIVE. End-of-warranty inspection will be conducted by Departmental Representative.
- .3 Departmental Representative reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

Part 2 Products

2.1 PLANT MATERIAL

- .1 Type of root preparation, sizing, grading and quality: comply to Canadian Standards for Nursery Stock.
 - .1 Plant material must be planted in zone indicated as appropriate for its species.
 - .2 Plant material in location appropriate for its species.
- .2 Plant material: Refer to Planting plan for quantities and material
- .3 Sound, healthy, vigorous, well branched and densely foliated when in leaf, free of disease, insects, defects or injuries and structurally sound with strong, well developed fibrous root system.
- .4 Freshly dug and in healthy condition at arrival on site. Heeled in plants or plants from cold storage will not be accepted. Whenever possible supply plants from the same hardiness zone and having the same soil characteristics as area of site.
- .5 Conform to measurements specified in plant list, except that plant lists larger than specified may be used if acceptable to the Departmental Representative without increase in Contract Price. If larger plants are accepted increase ball of earth in proportion to size of plant.
- .6 Stems: free of sunscalds, frost cracks, abrasions, fire and crust, with old injuries completely calloused over. Pruning wounds: showing vigorous bark on edges and parts with live, green cambium tissue.

- .7 Trees: with straight trunks, well and characteristically branched for species except where specified otherwise.
- .8 Trees larger than 200 mm in calliper: half root pruned during each of two successive growing seasons, the latter at least one growing season prior to arrival on site.
- .9 Bare root stock: nursery grown, in dormant stage, not balled and burlapped or container grown.
- .10 Collected stock: maximum 40 mm in calliper, with well developed crowns and characteristically branched; no more than 40% of overall height may be free of branches.
- .11 Material - Should the Contractor proceed to use material that is not shown on the approved planting plan and plant list, the Departmental Representative shall proceed to have such works corrected at the Contractor's expense.

2.2 TOPSOIL

- .1 Fertile, friable natural loam containing 4% minimum organic matter; acidity range from pH 6.0 to 7.5 and capable of sustaining vigorous plant growth; free of admixture of subsoil, lumps, stones and roots over 25mm diameter and other extraneous matter and reasonably free of weeds, weed seeds and rhizomes.

2.3 PEAT

- .1 Partially decomposed fibrous or cellular stems and leaves of Sphagnum Mosses with texture varying from porous to spongy fibrous with pH value ranging from 4.5 to 6.0 baled and free of decomposed colloidal residue, wood, sulphur and iron, brown in colour, finely shredded with particles 6mm maximum in size.
- .2 Peat, supplied in bulk, is not permitted unless acceptable to Departmental Representative upon submission of sample and location of source and supply.

2.4 BONEMEAL

- .1 Commercial, raw bonemeal, finely ground and with minimum analysis of 2% nitrogen and 11% phosphoric acid

2.5 LIME

- .1 Where pH of topsoil is less than 6.0, 8% minimum of calcium and magnesium carbonates combined, finely ground to pass #10 mesh sieve. Rate of application: Selected after determining pH of topsoil

2.6 WATER

- .1 Free of impurities that would inhibit plant growth.

2.7 WRAPPING MATERIAL

- .1 First quality burlap or heavy-duty waterproof crepe paper.

2.8 WIRE TIGHTENER

- .1 Type 1: galvanized steel, stamped plate type, rod, triangular in shape.
 - .2 Type 2: turnbuckle, galvanized steel, 9.5 mm diameter with 270 mm open length.
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2.9 GUYING WIRE

- .1 Type 1: steel, 3 mm wire.
- .2 Type 2: 1.5 mm diameter multi-wire steel cable.
- .3 Type 3: 3 mm diameter multi-wire steel cable.
- .4 Tree Straps to be soft polymer webbing, capable of breathing, not damaging or bruising young trees and available in 12 or 14 gauge

2.10 CLAMPS

- .1 U-bolt: galvanized, 13 mm diameter, c/w curved retaining bar and hex nuts.
- .2 Crimp type.

2.11 ANCHORS

- .1 Metal T bars, 38 x 38 x 5mm, painted black
or
- .2 Wood:
 - .1 Type 1: 38 x 38 x 460 mm.
 - .2 Type 2: 38 x 67 x 600 mm.
- .3 Drive-in type.
 - .1 Type 1: 13 mm diameter x 75 mm long, aluminum.
 - .2 Type 2: 18 mm diameter x 120 mm long, aluminum.
- .4 Screw-in type:
 - .1 Type 1: 100 mm diameter steel disc.

2.12 GUYING COLLAR

- .1 Tube: plastic, 13 mm diameter, nylon reinforced.
- .2 Coco rope, belting or tree straps in order to secure the tree firmly to the stakes.

2.13 TRUNK PROTECTION

- .1 Plastic: perforated spiralled strip.
- .2 Burlap: clean, minimum 2.5 kg/m² mass and 150 mm wide, and twine fastener.

2.14 MULCH

- .1 Trees and Shrub Beds – shredded pine mulch (SPM) or shredded well-decayed compost with oak leaf content not greater than 30% or Seasoned Pine or Black Beauty Mulch.
- .2 Wood Chip mulch collected from tree removal operation – EXCLUDING placement in areas near walkways.
- .3 Groundcover and Perennials Area – Shredded Compost.
- .4 All mulch as supplied by Gro-Bark Ont. Ltd., P.O. Box 453, Waterloo, N2J 4A0, (519) 885-3411 or Grower's Choice Kitchener, (519) 896-9459 or All Treat Farms, (519) 848-3145.

2.15 FERTILIZER

- .1 Complete commercial fertilizer, 50% of the elements of which shall be derived from organic sources, and containing no less than 60% urea-formaldehyde with percentages by weight of nitrogen, phosphoric acid and potash required to make up chemical deficiencies of soil and as required by plant growth.
- .2 Incorporate finely ground commercial superphosphate with a minimum analysis of 20% phosphorous (v) oxide.
- .3 Slow release fertilizers are to be used in case of late fall plantings.

2.16 ANTI-DESICCANT

- .1 Wax-like emulsion permeable enough to permit transpiration and delivered, missed and applied in accordance with manufacturer's recommendations.

2.17 FLAGGING TAPE

- .1 Fluorescent, red/orange colour.

2.18 SOURCE QUALITY CONTROL

- .1 Obtain approval from Departmental Representative of plant material prior to planting.
- .2 Imported plant material must be accompanied with necessary permits and import licenses. Conform to Federal, Provincial or Territorial regulations

Part 3 Execution

3.1 PRE-PLANTING PREPARATION

- .1 Do construction occupational health and safety in accordance with Section 01 35 20 Site Safety Requirements.
 - .2 Ensure plant material acceptable to Departmental Representative.
 - .3 Remove damaged roots and branches from plant material.
 - .4 Apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.
 - .5 Before excavating, ascertain location of electrical cables, conduits, utility lines, supply lines and sub-surface drainage. If such items are uncovered or if subsurface debris is uncovered, notify Departmental Representative and obtain instructions before relocating plant material or moving obstructions.
 - .6 Within the Area of Concern for ALHB (Asian Long Horned Beetle), the Contractor shall provide the following information to the Contract Administrator a minimum of two weeks prior to commencement of the work:
 - .1 The Name, Address and Location of the Nursery that will be supplying plant materials for the contract.
 - .2 Written confirmation that the Contractor has notified the Area Office of the Canadian Food Inspection Agency (CFIA) about the proposed host tree removals and a description of CFIA's response and any action taken.
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3.2 EXCAVATION AND PREPARATION OF PLANTING BEDS

- .1 Establishment of sub-grade for planting beds is specified in Section 31 22 13 - Rough Grading.
- .2 Preparation of planting beds is specified in Section 32 91 21 - Topsoil Placement and Finish Grading.
- .3 For individual planting holes:
 - .1 Stake out location and obtain approval from Departmental Representative prior to excavating.
 - .2 Excavate to depth and width as indicated.
 - .3 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material off site.
 - .4 Scarify sides of planting hole.
 - .5 Remove water which enters excavations prior to planting. Notify Departmental Representative if water source is ground water.
 - .6 Backfill planting beds and tree pits with soil mixture consisting of 4 parts topsoil to one part peat.
 - .7 Add bonemeal to soil at rate of 0.6 kg/m³.
 - .8 Mix topsoil soil mixture, peat moss and other additives thoroughly on site 2 days maximum before backfilling.
 - .9 Do not mix or backfill when topsoil is in muddy or frozen condition.
 - .10 Backfill to height above finished grade sufficient to allow for normal, natural settlement.
 - .11 Finish grade, after settlement: As shown on Contract Documents
 - .12 Tamp each layer firmly before placing subsequent layers to ensure the absence of air pockets.

3.3 PLANTING

- .1 For bare root stock, place 50 mm backfill soil in bottom of hole. Plant trees and shrubs with roots placed straight out in hole.
- .2 For jute burlapped root balls, cut away top one third of wrapping and wire basket without damaging root ball. Do not pull burlap or rope from under root ball.
- .3 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.
- .4 Plant vertically in locations as indicated. Orient plant material to give best appearance in relation to structure, roads and walks.
- .5 For trees and shrubs:
 - .1 Backfill soil in 150 mm lifts. Tamp each lift to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.
 - .2 Form watering saucer as indicated.
- .6 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.
- .7 Water plant material thoroughly.

- .8 After soil settlement has occurred, fill with soil to finish grade.
- .9 Dispose of burlap, wire and container material off site.

3.4 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as indicated.
- .2 Install trunk protection prior to installation of tree supports when used

3.5 TREE SUPPORTS

- .1 Install tree supports as indicated.
 - .2 Use single stake tree support for deciduous trees less than 3 m and evergreens less than 2 m.
 - .1 Place stake on prevailing wind side and 450 mm from trunk.
 - .2 Drive stake minimum 150 mm into undisturbed soil beneath roots. Ensure stake is secure, vertical and unsplit.
 - .3 Install 150 mm long guying collar 1500 mm above grade.
 - .4 Coco rope belting or tree straps. Secure guying to support post as per standard tree and nursery practices to ensure tree is supported from prevailing wind. Cut off any excess material.
 - .3 Use 3 guy wires and anchors for deciduous trees greater than 3 m and evergreens greater than 2 m.
 - .1 Use Type 2 guying wire with clamps for trees less than 75 mm in diameter and Type 3 guying wire with clamps for trees greater than 75 mm in diameter.
 - .2 Use Type 1 anchors for trees less than 75 mm in diameter and Type 2 anchors for trees greater than 75 mm in diameter.
 - .3 Install guying collars above branch to prevent slipping at approximately 2/3 height for evergreens and 1/2 height for deciduous trees. Collar mounting height is not to exceed 2.5 m above grade.
 - .4 Guying collars to be of sufficient length to encircle tree plus 50 mm space for trunk clearance. Thread guy wire through collar encircling tree trunk and secure to lead wire by clamp or multi-wraps; cut wire ends close to wrap. Spread lead wires equally proportioned about trunk at 120 degrees.
 - .5 Install anchors at equal intervals about tree and away from trunk so that guy wire will form 45 degree angle with ground. Install anchor at angle to achieve maximum resistance for guy wire.
 - .6 Attach guy wire to anchors. Tension wire and secure by installing clamps.
 - .7 Install wire tightener ensuring that guys are secure and leave room for slight movement of tree.
 - .8 Saw tops off wooden anchors which extend in excess of 100 mm above grade or as directed by Departmental Representative.
 - .9 Install flagging tape to guys as indicated.
 - .4 After tree supports have been installed, remove broken branches with clean, sharp tools.
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3.6 MULCHING

- .1 Spread Mulch in planting beds and around trees to a minimum depth of 75mm
- .2 Groundcover and Perennials Area – Shredded Compost spread to min. 50mm

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following maintenance operations from time of planting to acceptance by Departmental Representative.
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .2 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .3 Remove weeds monthly.
 - .4 Replace or re-spread damaged, missing or disturbed mulch.
 - .5 For non-mulched areas, cultivate as required to keep top layer of soil friable.
 - .6 If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval from Departmental Representative prior to application.
 - .7 Remove dead or broken branches from plant material.
 - .8 Keep trunk protection and guy wires in proper repair and adjustment.
 - .9 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

3.8 MAINTENANCE DURING WARRANTY PERIOD

- .1 From time of acceptance by Departmental Representative to end of warranty period, perform following maintenance operations.
 - .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
 - .2 Reform damaged watering saucers.
 - .3 Remove weeds monthly.
 - .4 Replace or re-spread damaged, missing or disturbed mulch.
 - .5 For non-mulched areas, cultivate monthly to keep top layer of soil friable.
 - .6 If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval from Departmental Representative prior to application.
 - .7 Apply fertilizer in early spring as indicated by soil test.
 - .8 Remove dead, broken or hazardous branches from plant material.
 - .9 Keep trunk protection and tree supports in proper repair and adjustment.
 - .10 Remove trunk protection, tree supports and level watering saucers at end of warranty period.
 - .11 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
 - .12 The Contractor shall not be responsible for the cost of replacements resulting from theft, vandalism, carelessness or neglect on the part of others or any other causes due to circumstances beyond his control.

- .13 Submit monthly written reports to Departmental Representative identifying:
 - .1 Maintenance work carried out.
 - .2 Development and condition of plant material.
 - .3 Preventative or corrective measures required which are outside Contractor's responsibility.

3.9 VERIFICATION

- .1 Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Local/regional materials.

END OF SECTION

Part 1 GENERAL

1.1 PRICE AND PAYMENT PROCEDURES

- .1 After television and photographic pipe inspections:
 - .1 If no defective work is found, Departmental Representative will pay costs for inspectors, trained operators, equipment rental and materials.
 - .2 If defective work is found, pay Departmental Representative a part of total inspection cost proportional to number of defective pipe sections of sewer to total number of pipe sections inspected.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D3034-, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .2 ASTM F794-, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-M89, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.9-94, Asbestos-Cement Sewer Pipe.
- .3 CSA International
 - .1 CAN/CSA-A3000-08, Cementitious Materials Compendium.
 - .2 CSA A257 Series-M92(R2009), Standards for Concrete Pipe.
 - .3 CAN/CSA-B1800-06, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.
 - .4 CSA G401-07, Corrugated Steel Pipe Products.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .3 Certification to be marked on pipe.
- .4 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .5 Manufacturer's Instructions: submit to Departmental Representative 1 copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .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 20.

Part 2 PRODUCTS

2.1 PLASTIC PIPE

- .1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D3034 .
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Locked-in gasket and integral bell system.
 - .3 Nominal lengths: 4 m.
- .2 Large diameter, ribbed PVC sewer pipe and fittings: to ASTM F794.

2.2 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material in accordance following requirements:
 - .1 OPSS 1010, Granular A, maximum size 19 mm.
 - .2 Crushed or screened stone, gravel or sand.
 - .3 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.2 Table:

Sieve Designation (mm)	% Passing	
	Stone/Gravel	Gravel/Sand
200	-	-
75	-	-
50	-	-
38.1	-	-
25	100	-
19	-	-
12.5	65-90	100
9.5	-	-
4.75	35-55	50-100
2.00	-	30-90
0.425	10-25	10-50
0.180	-	-
<u>0.075</u>	<u>0-8</u>	<u>0-10</u>

.3 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00.

2.3 BACKFILL MATERIAL

.1 As indicated 31 00 00.01.

Part 3 EXECUTION

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according sediment and erosion controls as indicated on the Site Grading Plan (C2.10).
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

.1 Protect trench from contents of sewer.

.2 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

- .3 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and approved by Departmental Representative.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm above invert of pipe.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.4 INSTALLATION

- .1 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .2 Make watertight connections to manholes and catch basins.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .3 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
 - .1 Joint to be structurally sound and watertight.
- .4 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
 - .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to springline of pipe to at least 95% maximum density to ASTM D698.
 - .6 Compact each layer from springline of pipe to underside of backfill to at least 95% maximum density to ASTM D698.
 - .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.
-

3.6 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698. In other areas, compact backfill to at least 90% maximum density to ASTM D698.
- .4 Place unshrinkable backfill in accordance with Section 31 00 00.01.

3.7 FIELD TESTS AND INSPECTIONS

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Remove foreign material from sewers and related appurtenances by flushing with water.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION



**Jacques Whitford
Environment Limited**

Consulting Engineers
Environmental Scientists
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ISO 9001

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March 25, 2004

Project No. ONT36539.2

Public Works and Government Services Canada
Environmental Services
4900 Yonge Street, 11th floor
Toronto, Ontario M2N 6A6

Attention: Mr. Lee Chan

**Re: Designated Substances and Hazardous Materials Survey - Final Report
Grand Valley Institution for Women
1575 Homer Watson Boulevard, Kitchener, Ontario**

Dear Mr. Lee:

Please find enclosed the final report for the Designated Substances and Hazardous Materials Survey undertaken at the above-noted facility.

We trust this report satisfies your needs at the present time. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Thank-you for providing us with the opportunity to assist you with this project.

Sincerely,

JACQUES WHITFORD ENVIRONMENT LIMITED

Andy Andriotis, P.Eng.
Project Manager

Enclosure

FINAL REPORT
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
DESIGNATED SUBSTANCES AND
HAZARDOUS MATERIALS SURVEY
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO

PROJECT NO. ONT36539.2



Project No. ONT36539.2

Final Report To

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

On

**DESIGNATED SUBSTANCES AND
HAZARDOUS MATERIALS SURVEY**

**GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

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March 25, 2004



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EXECUTIVE SUMMARY

Public Works and Government Services Canada (PWGSC), on behalf of Correctional Services Canada (CSC), retained Jacques Whitford Environment Limited (Jacques Whitford) to conduct a designated substances and hazardous materials survey of the Grand Valley Institution for Women located at 1575 Homer Watson, Kitchener, Ontario. The scope of the survey was expanded to include hazardous materials such as polychlorinated biphenyls (PCBs), ozone-depleting substances (ODSs), urea-formaldehyde foam insulation (UFFI), mould and radioactive materials. As an additional component to the survey, an inventory of hazardous products stored at the facility was also undertaken. The hazardous materials observed at the time of the site visit included a variety of cleaning products, paints and small quantities of insecticides.

All work carried out met the requirements of *Section 30* of the Ontario Occupational Health and Safety Act (OHSA). The designated substances survey list are those designated under the OHSA and included (but were not limited to) asbestos, lead, mercury and silica as the most likely to be present. Site work was conducted between March 1 and March 4, 2004.

The purpose of the investigation was to identify any potential designated substances that may require special attention prior to conducting demolition of the subject facility as required under the OHSA.

Based on visual inspection and laboratory analysis, designated substances and hazardous materials were identified to be present in the subject areas. **Table 1** below provides a summary of the materials identified at the subject property and recommendations on their management.

Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
Acrylonitrile	Possibly present in paints and adhesives.	See lead recommendations.
Arsenic	Possibly present in paints and adhesives.	See lead recommendations.
Asbestos	Friable and non-friable asbestos-containing materials (ACM) were not identified by laboratory analysis to be present in the subject buildings. Roofing materials were not sampled however asbestos is not expected to be present within these materials based on the age of the subject	Should a material suspected to contain asbestos fibres become uncovered during renovation or demolition activities, all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if asbestos fibres are present.



Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
	buildings.	<p>Prior to renovation or demolition activities, collect samples of roofing materials for laboratory analysis to confirm that asbestos fibres are not present.</p> <p>Confirmed asbestos-containing materials should be handled in accordance with RRO 838/90 and disposed of in accordance with RRO 558/00.</p>
Benzene	Likely present in stable form in paints and adhesives.	None required.
Coke Oven Emissions	None identified.	None required.
Ethylene Oxides	None identified.	None required.
Isocyanates	None identified.	None required.
Lead	<p>Lead was not identified to be present (i.e. at a concentration greater than 5,000 ppm or 0.5% by weight) in the six (6) paint chip samples of major paint applications noted to be present throughout the subject buildings.</p> <p>Lead may be present within other applications (e.g. solder in electronic equipment; solder caulking in bell fittings for cast iron pipes; ceramic tile glaze, vent and pipe flashings).</p>	<p>Corrective action or remedial work on materials that may contain lead should be undertaken in a manner so as to avoid generating fine particulate matter or fumes. Airborne lead dust or fumes should not exceed the Ministry of Labour Time Weighted Average Exposure Value of 0.05 mg/m³ during the removal of paints and products containing any concentration of lead.</p> <p>Construction or renovation work that may disturb lead-containing materials should follow the recommendations provided in the document entitled "Draft Guideline: Lead on Construction Projects", issued by the Ministry of Labour on December 5th, 2002.</p>
Mercury	Mercury vapour is suspected to be present in the approximately 1,000 fluorescent light tubes and 300 vapour bulbs identified in various subject buildings.	Mercury or mercury vapour poses no risk to workers or occupants provided the mercury containers remain intact and undisturbed.



Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
	Mercury may also be present in paints and adhesives.	Complete removal of mercury-containing equipment is required prior to demolition or renovation activities that may disturb the equipment and disposed of in accordance with RRO 558/00.
Silica	Silica may be present in concrete, cement, mortar, acoustical ceiling tiles and ceramic tile materials that were identified to be present at the subject facility.	<p>Ensure workers performing demolition activities are not exposed to airborne silica levels in excess of 0.05 mg/m³ by providing respiratory protection, wetting down work area and providing workers with a station to properly wash prior to exiting the work area.</p> <p>Construction or renovation work that may disturb silica containing materials should follow the recommendations provided in the document entitled “Draft Guideline: Silica on Construction Projects”, issued by the Ministry of Labour on December 5th, 2002.</p>
Vinyl Chloride	Likely present in stable form in pipes, conduits and interior finishes.	None required.
Polychlorinated Biphenyl (PCBs)	<p>A representative number of fluorescent light ballasts were inspected for PCB content. All of the ballasts inspected were marked as “no PCBs”. Based on the age of the building and the information from the ballasts that were inspected, other ballasts are not expected to contain PCBs.</p> <p>Transformers were identified to be present at various locations throughout the subject facility. These transformers are of the dry type and do not contain a dielectric fluid. Therefore PCBs in transformers are not a concern.</p>	None required.



Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
Ozone-Depleting Substance (ODS)	<p>All roof mounted HVAC units were identified by their nameplates to have been factory charged with R-22 refrigerant, an ozone depleting substance.</p> <p>All refrigeration compressor units located throughout the facility (along north catwalk, east mezzanine and south platform) were identified to be charged with Freon, an ozone-depleting substance.</p> <p>Coolers, refrigerators, freezers observed throughout the facility were confirmed or suspected to contain CFC/HCFC.</p>	<p>The ozone-depleting substances identified to be present in the subject buildings should be removed by a licenced contractor prior to demolition of the subject building. When removing the refrigeration and cooling equipment, they should be handled such that there is no release of ODS into the atmosphere in accordance with applicable regulations.</p> <p>Units containing R12 should have the refrigerant removed in accordance with applicable regulations.</p> <p>Units containing R22 should have the refrigerant removed when such units are taken out of service and decommissioned.</p>
Urea Formaldehyde Foam Insulation (UFFI)	None identified.	None required.
Mould	<p>Water damage was observed in Dwelling Units E1 to E4, and E7 to E9. Water infiltration is suspected to be the source of a bulge in the drywall of the second floor hall of Dwelling Unit E8.</p> <p>Suspected mould growth was observed on the caulking of bathtubs in Dwelling Units E4 and E7.</p>	<p>Consideration should be given to conducting an intrusive mould investigation at locations where water damage or damage to caulking was identified.</p> <p>Areas of the facility identified to contain dark staining should be remediated and the source of moisture eliminated.</p>
Radioactive Materials	An x-ray inspection system and dental x-ray unit were identified to contain radioactive sources.	The equipment identified to contain radioactive materials should be maintained in accordance with manufacturer's specifications and in compliance with applicable regulations.
Fuels, Oil and Waste Oil Storage	Two diesel fuel storage tanks are located on the property for the backup generator. One double-walled aboveground storage tank	The diesel fuel AST located outside requires content identification of lines by way of markings [National Fire Code],



Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
	<p>(2200 L) is located outside the maintenance building and the second aboveground storage tank (day tank) (908 L) is located inside the maintenance building within a secondary containment system.</p> <p>Jerry cans of petroleum fuels, oils and lubricants were noted to be stored in the Garbage/Compact/Recycling Building (GVG01).</p>	<p>detailed plans for piping systems [National Fire Code] and comprehensive annual inspections [CCME].</p> <p>Jerry cans of petroleum fuels, oils and lubricants are stored in the Garbage/Compact/ Recycling Building (GVG01) without secondary containment that should be installed around the containers storing Petroleum, Oils and Lubricants (POLs).</p> <p>Additional recommendations with respect to training and spill response plans are provided in Jacques Whitford's compliance audit report entitled "Environmental Condition and Operations Audit, Grand Valley Institution for Women AERP, Correctional Services of Canada", dated March 11, 24 for Public Works and Government Services Canada.</p>
Hazardous Material Storage	<p>An area-by-area inventory of hazardous materials stored at the facility is provided in Appendix 12.</p> <p>The hazardous materials observed to be present at the time of the site reconnaissance consisted predominantly of various cleaners, paints and small quantities of insecticide. Hazardous materials no longer in use were stored in various locations, for example, Main Building Basement Boiler Room and Maximum Security Area.</p> <p>Workplace Hazardous Materials Information System (WHMIS) based labelling was not observed to be present on all storage containers</p>	<p>Inventories of areas where hazardous materials are stored should be posted at each storage area.</p> <p>Hazardous materials no longer in use should be disposed of in accordance with applicable regulations.</p> <p>Material Safety Data Sheets should be readily available and current.</p> <p>Products should be labelled in accordance with WHMIS requirements.</p> <p>Propane cylinders kept in the locked</p>

Table 1 – Summary of Findings and Recommendations		
Issue	Comments	Recommendation
	<p>and Material Safety Data Sheets (MSDS) were not readily available for products that were identified and many were out of date.</p> <p>Propane Cylinders are kept in a locked propane cage by the Maintenance shed. Signage identifying the storage area and a “No Smoking” sign were missing.</p>	<p>propane cage by the Maintenance shed should have appropriate signage including a “No Smoking” sign.</p> <p>Additional recommendations with respect to the handling and labelling of hazardous products are provided in Jacques Whitford’s compliance audit report entitled “Environmental Condition and Operations Audit, Grand Valley Institution for Women AERP, Correctional Services of Canada”, dated March 22, 2004 for Public Works and Government Services Canada.</p>

The statements made in this Executive Summary text are subject to the same limitations included in the Closure Section 7.0, and are to be read in conjunction with the remainder of this report.

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC), on behalf of Correctional Services Canada (CSC), retained Jacques Whitford Environment Limited (Jacques Whitford) to conduct a designated substances and hazardous materials survey of the Grand Valley Institution for Women located at 1575 Homer Watson, Kitchener, Ontario. The scope of the survey was expanded to include hazardous materials such as polychlorinated biphenyls (PCBs), ozone-depleting substances (ODSs), urea-formaldehyde foam insulation (UFFI), mould and radioactive materials. As an additional component to the survey, an inventory of hazardous products stored at the facility was also undertaken. The hazardous materials observed at the time of the site visit included a variety of cleaning products, paints and small quantities of insecticides.

All work carried out met the requirements of *Section 30* of the Ontario Occupational Health and Safety Act (OHSa). The designated substances survey list are those designated under the OHSa and included (but were not limited to) asbestos, lead, mercury and silica as the most likely to be present. Site work was conducted between March 1 and March 4, 2004.

The purpose of the investigation was to identify any potential designated substances and hazardous materials that may require special attention prior to conducting demolition of the subject facility as required under the OHSa.

1.1 Facility Description

Grand Valley Institution for Women is located in the City of Kitchener. The institution is situated towards the southern boundary of the city, in a suburban area to the south of the downtown core. The facility is accessed from Homer Watson Boulevard, approximately 400 m east of that street's intersection with Manitou Drive. The property is currently owned by CSC.

The CSC property on which the Grand Valley Institution for Women is located comprises approximately 10 hectares. The property forms a rough "L"-shape which extends north from Homer Watson Boulevard and then angles west towards Manitou Drive.



Adjacent properties are as follows:

- South: Homer Watson Blvd.
- Southwest: Lear Siegler Corp. Canada, a manufacturer of automobile seat components, is located within the “angle” of the “L”-shape, occupying the land at the intersection of Homer Watson Blvd. and Manitou Drive. A ridge, approximately 5 m high and declining to the east, extends along the western side of the institution Property. The top of this ridge marks the boundary between the institution land and the Lear Liegler land to the west.
- West and Northwest: Along Manitou Drive – industrial operations
- North, northeast and East: Open lands including Homer Watson Park
- East: Open lands (Schneider Creek runs from north to south) including Homer Watson Park and Doon Heritage Crossroads Pioneer Village and an abandoned CN railway line.

Two shallow retention ponds for stormwater runoff are located in shallow depressed areas on the property, one at the north end and the other in the southeast corner. A network of storm sewers and ditches directs runoff water to the ponds. The pond in the north discharges directly to Schneider Creek, while the other discharges to a ditch on the north side of Homer Watson Boulevard. There are no natural watercourses or waterbodies located on the property. The landscaped grounds include parking lots, paved walking paths and grass areas.

There is one large building, a maintenance building, two storage sheds, a garbage/compact/ recycling room, a greenhouse, a segregation trailer, a family visit building (two units), a structured living environment unit, and 11 houses on the property. The large building, the Main Building, includes offices, a kitchen, beauty salon, classrooms, storage rooms, residence, gymnasium, hospital and dental care, and maintenance and boiler rooms.

The entire facility property has served as a correctional institution since its construction in 1996. Some additions to the facility have been made since the initial construction. At the present time, the facility houses approximately 98 inmates and approximately 80 fulltime employees at any given time.

A complete list of the buildings located at the subject facility including information on the use of each building and general construction is provided in **Table 2**. A site plan of the facility and

floorplan drawings for each of the buildings is presented in Appendix 2 and Appendix 3 respectively.

Table 2 – List of Buildings at Subject Facility				
Building I.D.	Building Name	Use/Activities	General Construction	Number of Levels
GVA01	Main	Offices; Kitchen; Beauty salon; Classrooms; Storage rooms; Residence; Gymnasias; Hospital and Dental Care; Maintenance Rooms; Boiler Rooms; and Maximum Security Unit.	Concrete foundation with partial basement, drywall interior partitions, block exterior walls, textured plaster-like exterior veneer, flat tar and gravel roof.	3
GVE01	Dwelling E1	Residence	Concrete foundation with crawlspace, drywall interior partitions, wood frame construction, vinyl siding exterior, and sloped shingle roof.	3
GVE02	Dwelling E2	Residence	Same as GVE01.	3
GVE03	Dwelling E3	Residence	Same as GVE01.	3
GVE04	Dwelling E4	Residence	Same as GVE01.	3
GVE05	Dwelling E5	Residence	Same as GVE01.	3
GVE06	Dwelling E6	Residence	Same as GVE01.	3
GVE07	Dwelling E7	Residence	Same as GVE01.	3
GVE08	Dwelling E8	Residence	Same as GVE01.	3
GVE09	Dwelling E9	Residence	Same as GVE01.	3
GVE10	Structured Living Environment Unit	Programs Room and 24-Hour Supervised Living Quarters	Concrete foundation, drywall interior partitions, wood frame construction, vinyl siding exterior, and sloped shingle roof.	1
GVE11	Dwelling E11	Residence	Same as GVE01.	3
GVE12	Dwelling E12	Residence	Same as GVE01.	3
GVF01	Family Visit F1	Residence	Same as GVE01.	2
GVF02	Family Visit F2	Residence	Same as GVE01.	2
GVG01	Garbage/Compact /Recycling	Storage Rooms	Concrete slab-on-grade construction, block walls, textured plaster-like exterior veneer, and metal roof.	1
GVM01	Maintenance	Offices; Grounds-keeping Equipment and Maintenance; Storage; Kitchen	Concrete slab-on-grade construction, block walls, vinyl siding and sloped shingle roof.	1
GVSS	Storage Sheds	Shed	Dirt floor with plastic walls and roof.	1
GVST	Segregation Trailer	Residence	Drywall interior partitions, block-like exterior siding, and flat metal roof.	1



1.2 Survey Objectives

The objective of the investigation was to:

- prepare a survey report that identifies any potential designated substances and hazardous materials that may require special attention prior to conducting demolition or renovation of the subject facility as required under the OHSA;
- provide recommendations for the management of these materials; and,
- provide an opinion of probable cost for the removal of these materials.

1.3 Scope of Work

The scope of work for this survey involved the following:

- a review of existing information, including site drawings and previous survey reports, where available;
- a “room-by-room” visual inspection of the room spaces located at the subject facility for the presence of designated substances and hazardous materials;
- the collection of representative bulk samples from building materials suspected of containing asbestos fibres for the determination of the type and concentration of asbestos;
- the collection of representative paint chip samples from building surfaces for the determination of the lead content in paint finishes; and,
- preparation of a report documenting the results of the survey, providing an interpretation of the laboratory analysis results and recommendations for the management of designated substances and hazardous materials identified.

1.4 Project Team

The Jacques Whitford project team responsible for undertaking this assessment consisted of the following individuals:

Andy Andriotis, P.Eng.
David Stevens

Project Manager/Engineer and Senior Technical Reviewer
Senior Field Technician



1.5 Facility Personnel

CSC facility personnel that were interviewed to obtain information relevant to this project included the following individuals:

- Ray Carney – Chief of Engineering and Maintenance Services
- Eric Broadbent - Assistant Team Leader

The Jacques Whitford field inspector was accompanied by a staff member of Barber-Collins Security Services Limited who provided escort and access to all areas of the facility for the duration of the project.

2.0 DOCUMENT REVIEW

The following documents were provided by PWGSC and reviewed by Jacques Whitford to develop a better understanding of site conditions in advance of our field inspection:

- “Phase 1 Environmental Site Assessment”, Grand Valley Institutions for Women, Volume 1 / 4 (Institution No. 465), Correctional Service Canada, PWGSC – Environmental Services, Ontario Region, March 1999;
- “Storage Tank Compliance Assessment”, Grand Valley Institutions for Women, Volume 2 / 4 (Institution No. 465), Correctional Service Canada, PWGSC – Environmental Services, Ontario Region, March 1999; and,
- “Inspection Report – Hazardous Materials and Waste”, Grand Valley Institutions for Women, Volume 3 / 4 (Institution No. 465), Correctional Service Canada, PWGSC – Environmental Services, Ontario Region, March 1999.

3.0 SURVEY METHODOLOGY

The inspection of the subject facility located at 1575 Homer Watson Boulevard was conducted by Mr. David Stevens of Jacques Whitford between March 1 and March 4, 2004. The facility materials and contents were visually examined to determine the presence of the following designated



substances in accordance with the requirements of the OHSA, *Section 30*:

- Acrylonitrile RRO 835/90;
- Arsenic RRO 836/90;
- Asbestos RRO 837/90 and 838/90;
- Benzene RRO 839/90;
- Coke Oven Emissions RRO 840/90;
- Ethylene Oxide RRO 841/90;
- Isocyanates RRO 842/90;
- Lead RRO 843/90;
- Mercury RRO 844/90;
- Silica RRO 845/90; and,
- Vinyl Chloride RRO 846/90.

In addition to the designated substances listed above, a visual inspection for the following hazardous materials was completed:

- Polychlorinated biphenyls;
- Ozone-Depleting Substances;
- Urea Formaldehyde Foam Insulation;
- Mould; and,
- Radioactive materials.

An inventory of hazardous product stored at the facility was also undertaken for the subject facility.

Refer to **Appendix 1** for background information on the above mentioned designated substances and hazardous materials. A list of definitions for technical terms used in this report is provided in **Appendix 16**.

A description of the methodology used to inspect for the more common designated substances typically found in buildings including asbestos, lead, silica and mercury, is provided in the following sections.

3.1 Asbestos

A room-by-room visual inspection of all accessible areas of the subject buildings were made in order to determine the presence of materials suspected of containing asbestos and to assess the potential risk of exposure to facility users based on the condition and accessibility of the materials.

During the inspection, locations to collect discrete bulk asbestos samples of suspect building materials were identified. Samples of representative materials were then collected at these locations following the asbestos bulk sampling procedures prescribed in *Code for the Determination of Asbestos by Bulk Samples*, dated the 23rd of August, 1985 and issued by the Ministry of Labour in Regulation 838 of the Revised Regulations of Ontario, 1990 (RRO838/90), *the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, made under the *Occupational Health and Safety Act*.

An assessment of the condition, accessibility and exposure risk was completed for each occurrence of an asbestos-containing material, where applicable. The Public Works and Government Services Canada (PWGSC) document entitled "Deputy Ministers Directive 057 – Asbestos Management" (Last Revised 1999/07/16) was used as the basis for the criteria that was applied in evaluating the presence of asbestos-containing materials at the subject areas.

Fifteen bulk samples of building materials suspected of containing asbestos fibres were collected and submitted to EMSL Analytical, Inc. (EMSL) of Westmont, New Jersey. EMSL holds current Certificate of Accreditation for Bulk Asbestos Fibre Analysis under the National Voluntary Laboratory Accreditation Program (NVLAP).

Of the 15 samples, 7 samples were submitted for analysis using a combination of dispersion staining and polarized light microscopy (PLM). The PLM analysis follows the National Institute for Occupational Safety and Health (NIOSH) Method 9002 and the Ministry of Labour Code for Determination of Asbestos from Bulk Samples (1985). The bulk samples were identified as BS-01, BS-03, BS-05, BS-07, BS-10, BS-12 and BS-15.

The remaining 8 samples were submitted for analysis using the Transmission Electron Microscopy (TEM) Chatfield Method (revision 2). TEM analysis is used to determine the presence of asbestos fibres in samples where the fibres are fine or obscured by tightly binding matrices such as in floor tiles and other non-friable materials. These bulk samples were identified as BS-02, BS-04, BS-06,



BS-08, BS-09, BS-11, BS-13 and BS-14.

A copy of the PLM and TEM analytical reports are located in **Appendix 13**.

A summary list of the bulk samples collected including a description of the material, sampling location, type of analysis and laboratory test results is provided in **Appendix 4**. The sampling locations are also indicated in the floor plans presented in **Appendix 3**.

3.2 Lead

A room-by-room visual inspection of all accessible areas of the subject facility was made in order to determine the presence of materials that may contain lead. These materials included paint applications, wiring and plumbing etc. Six samples of representative paint applications were sent to Philips Analytical Services Corporation (PASC) of Mississauga, Ontario, an accredited laboratory, for lead content analysis following US EPA SW 846 Method 3050.

The sampling of paint applications involved the collection of paint chip samples of paint layers to the substrate. A minimum volume of 5cc or ½ teaspoon of paint chips was typically collected. Wherever necessary and possible, paint was separated from any backing material such as paper, concrete or wood and placed in a sealed clearly labelled plastic bag.

A copy of the laboratory Certificate of Analysis for the paint chip testing is included in **Appendix 14**.

A summary list of the samples collected including a description of the samples, sampling locations and laboratory analysis results is provided in **Appendix 6**. The sampling locations are also indicated in the floor plans presented in **Appendix 3**.

3.3 Silica

An inspection for the presence of silica was completed throughout the subject building. The presence of silica in building materials such as concrete, masonry, stone, terrazzo, refractory brick, ceiling tiles etc. was noted during the inspection.



3.4 Mercury

An inspection for equipment, which is likely to contain mercury, was completed for each room space. Information on the type of equipment (i.e. gauges, switches, batteries, thermometers, thermostats etc.), model and serial numbers, and quantities was recorded, where available.

A room-by-room summary of all occurrences of mercury-containing equipment identified in the subject building is provided in **Appendix 8**.

3.5 Polychlorinated Biphenyl

An inspection for the presence of PCBs in electrical equipment was completed for each room space. Equipment that is generally suspected of containing PCBs includes lamp ballasts, transformers, switchgear and capacitors. An inventory of all equipment including quantities, manufacturer and nameplate information was documented, where available and is presented in **Appendix 9**.

Lamp Ballasts

A representative number of fluorescent lamp ballasts were examined throughout the subject buildings. To avoid the risk of electric shock, ballasts were examined in-place (i.e. not extracted) for markings on exposed surfaces. Information on the ballasts was recorded for comparison with the Environment Canada reference document, "*Identification of Light Ballasts Containing PCBs (Report EPS 2/CC/2, revised August 1991)*" to determine if the ballasts were likely to contain PCBs. Lamp ballasts that were not clearly marked as not containing PCBs or that were not listed in the Environment Canada guide as "non-PCB" were considered to be suspect and inventoried as containing PCBs.

Transformers

Transformers were inspected for the potential presence of PCB-containing dielectric fluid based on nameplate and transformer type.

3.6 Ozone-Depleting Substances

An inspection for equipment likely to contain ozone-depleting substances was completed for each room space in the subject building. Information on the type of equipment, manufacturer and type and quantity of refrigerants was recorded, where available.



A room-by-room summary of all occurrences of ODS-containing equipment identified at the subject facility is provided in **Appendix 10**.

3.7 Urea Formaldehyde Foam Insulation

An inspection for the potential presence of urea formaldehyde foam insulation was completed. This involved the inspection of exterior and interior walls for evidence of repaired openings (i.e. nozzle holes) made to facilitate the installation of the insulation. Wherever possible, an inspection of wall cavities through existing openings was made.

3.8 Mould

An inspection of accessible surfaces within the room spaces of the subject facility was undertaken by Jacques Whitford to identify areas where mould was most likely to proliferate (i.e. areas where water damage/staining was visible on building material surfaces). Intrusive inspections and bulk sampling to confirm the presence of mould was not undertaken during the survey.

A room-by-room summary of areas where mould or water damaged building materials were observed in the subject buildings is provided in **Appendix 11**.

3.9 Radioactive Materials

An inspection for equipment likely to contain radioactive materials was completed for each room space in the subject facility. Information on the type of equipment, manufacturer and type of radioactive material was recorded, where available. Information was also obtained through interviews with facility staff.

3.10 Fuels, Oils and Waste Oil Storage

During the site visit, the storage of fuels, oils and waste oils were recorded including information on the type of containment, storage location, capacity, intended use and other relevant information.

3.11 Hazardous Material Storage

During the inspection of the subject facility, Jacques Whitford documented the occurrences of



hazardous materials (as set out in the federal *Hazardous Products Act*) that are used and stored at the site. The information collected included names of products used on site, their intended use, manufacturer information, quantities, type of container, storage location of products and other relevant information.

A room-by-room summary of hazardous materials that are stored throughout the subject facility is provided in **Appendix 12**.

4.0 SURVEY LIMITATIONS

This report reflects the observations, findings and analysis of materials sampled at the time of the survey. Analytical results reflect the sampled materials at the specific sampling locations. Visually similar materials were referenced to specific analysed samples.

Limited access into the walls and ceiling cavities was obtained for the investigation of insulation materials. The observations presented herein are based on the specific areas inspected and, hence, the findings may not be consistent throughout the building.

5.0 REGULATORY FRAMEWORK

The Occupational Health and Safety Act (OHSA) sets out in general terms, the duties of employers and others to protect the health and safety of workers from hazards that may be present in the workplace. More specific requirements pertaining to the presence of designated substances on construction projects are provided under *Section 30* of the OHSA. For each of the eleven designated substances, *Section 30* requires that prior to beginning a construction or demolition project, the owner is to determine if designated substances are present at a site and prepare a list of materials containing designated substances. If designated substances are identified to be present, all potential contractors (and subcontractors) bidding on the project must be provided a copy of the list as part of the tendering information.

Provisions are also made under O. Reg. 213/91 to protect workers from situations where exposure to hazardous materials is possible on a construction site. The requirements under O. Reg. 213/91 pertain (but are not limited) to the following:



- the competency of the person performing tests and making observations necessary for the detection of hazardous conditions on a construction project;
- the provision of adequate washing facilities for workers that may come into contact with hazardous materials that may endanger their health;
- the provision of adequate ventilation by natural or mechanical means if a worker may be injured by exposure to hazardous gases, dusts, fumes;
- the provision of adequate personal protective equipment, such as suitable respirators, when it is not practical to provide natural or mechanical ventilation in areas where a worker may be injured by exposure to hazardous gases, dusts, fumes; and,
- measures to be taken for an underground workplace where noxious or toxic gases, fumes or dusts exist.

Materials destined for disposal are subject to the requirements of O. Reg. 558/00. Under this regulation, information on the type of waste is used to classify the waste based on its hazardous properties or characteristics.

A description of the regulatory framework specific to the more common designated substances typically found in buildings including asbestos, lead, silica and mercury and other hazardous materials such as PCBs, ODSs, UFFI, radioactive materials and mould are provided in the following sections.

5.1 Asbestos

Asbestos is included in the Designated Substances Regulations made under Ontario's Occupational Health and Safety Act. The Regulation Respecting Asbestos (R.R.O. 1990, Reg. 837, formerly 655/85) primarily regulates worker exposure to asbestos, in conjunction with codes related to respiratory equipment, measurement of airborne fibres, and medical surveillance of exposed workers.

The disturbance of ACMs on construction projects is governed by Regulation 838 of the Revised Regulations of Ontario (1990), as amended by RRO 510/92, formerly Regulation 654/85 - Regulation Respecting Asbestos on Construction Projects and in Building and Repair Operations. ACMs must be removed prior to any demolition or renovation that may potentially disturb the asbestos materials.

The Waste Management Regulation (*O. Regulation 558/00*) requires the disposal of asbestos waste



in a double sealed container, properly labelled and free of cuts, tears or punctures. The waste must be disposed of at a licensed waste station which has been properly notified of the presence of asbestos waste.

The transport of asbestos waste to the disposal site is covered by the federal Transportation of Dangerous Goods Act (1992). Asbestos waste is to be handled by a licensed waste hauler.

5.2 Lead

Under Ontario Regulation 843 of the Occupational Health and Safety Act, a regulatory limit has been established for occupational exposure to airborne lead that may be present in a workplace. The occupational exposure limit (OEL) for airborne lead dust or fumes should not exceed the Ministry of Labour Time Weighted Average Exposure Value (TWAEV) of 0.05 milligram per cubic metre of air (mg/m^3) for workers. The TWAEV represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

Although the OEL and some other requirements under O. Reg. 843 do not apply to construction projects, procedures that provide the equivalent level of protection should be implemented on such projects where exposure to lead is a hazard.

The Hazardous Products Act in Canada and the United States Department of Housing and Urban Development (HUD) have set a criteria of 0.5 % lead (by weight) or 5,000 parts per million (ppm) for determining if a paint application should be considered lead-based. The US Centre for Disease Control (CDC) notes that the 0.5 % level is based on practical, not health concerns, so care must be taken when this criteria is applied.

5.3 Mercury

Mercury is included in the Designated Substances Regulations made under Ontario's Occupational Health and Safety Act. The Regulation Respecting Mercury (R.R.O. 1990, Reg. 844) applies to every employer and worker at a workplace where mercury is present, produced, processed, used, handled, or stored and at which the worker is likely to inhale, ingest, or absorb mercury. Requirements related to exposure to mercury are detailed, including those relating to worker safety and the use of personal protective equipment.



Ontario's Waste Management (O. Regulation 558/00) under the Environmental Protection Act provides directives for the disposal of hazardous materials such as mercury.

5.4 Silica

Silica is included in the Designated Substances Regulations made under Ontario's Occupational Health and Safety Act. The Regulation Respecting Silica (R.R.O. 1990, Reg. 845) which provides information on the application of the regulation, allowable exposure levels (the maximum TWAEV for airborne Silica dust is 0.05 mg/m^3), the assessment and control program and medical surveillance requirements.

5.5 Polychlorinated Biphenyls (PCBs)

The use of PCBs in electrical equipment such as transformers and capacitors, including capacitors found in fluorescent lamp ballasts, was common up to 1980. The Federal Chlorobiphenyls Regulation, SOR/91-152, and Ontario Regulation 362 under the Environmental Protection Act, prohibits the use of PCBs in electrical equipment installed after July 1, 1980.

5.6 Ozone-Depleting Substances (ODS)

Ozone-depleting substances (ODSs) are chemical agents known as chlorofluorocarbons (CFCs), halon, hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), usually used in freezers and compressors for refrigeration. They have also been used as aerosol additives and in the production of foam insulation. In accordance with the "Montreal Protocol", which is an international effort to reduce the use of ODSs worldwide, the use of ODSs is regulated in Ontario under the Environmental Protection Act (EPA), Part VI, the Ozone Depleting Substances - General Regulation (R.R.O. 1990, Reg. 356 amended to O. Reg 351/93) and the Refrigerants Regulation (O. Reg. 189/94 amended to O. Reg 519/97) and under the Canadian Environmental Protection Act (CEPA), Ozone-Depleting Substances Regulations, 1998 SOR/99-7 and Federal Halocarbon Regulation 2003 (SOR/2003-289) that applies to federal land, aboriginal land and federal works and undertakings.

5.7 Urea Formaldehyde Foam Insulation (UFFI)

Urea formaldehyde foam insulation is an insulating foam plastic that was injected into the wall cavities of building between 1977 and 1980, when it was banned in Canada.



5.8 Mould

There are currently no regulations in Canada pertaining specifically to mould in buildings. However, based on an Ontario Ministry of Labour alert, employers are required by section 25(2)(h) of the Occupational Health and Safety Act to take every precaution reasonable in the circumstances for the protection of workers.

The Occupational Health and Safety Act place a responsibility on constructors (section 23), employers (section 25), and supervisors (section 27) to ensure the health and safety of workers. This includes protecting workers from mould in workplace buildings. Various sections of the Industrial, Construction, Mining or Health Care regulations may also apply to maintenance and remediation activities.

Several guidelines and other resources describe procedures for the investigation and remediation of mould. The following documents indicate that mould observed in occupied building should be remediated in accordance with these procedures;

- “Guidelines on Assessment and Remediation of Fungi in Indoor Environment”, New York City Department of Health, Bureau of Environmental & Occupational Disease Epidemiology, April 2000;
- “Bioaerosols: Assessment and Control”, American Conference of Governmental Industrial Hygienists (ACGIH), 1999;
- “Fungal Contamination in Public Buildings: A Guide to Recognition and Management”, Health Canada, Federal-Provincial Committee on Environmental and Occupational Health, June 1995;
- “Indoor Air Quality in Office Buildings: A Technical Guide”, Health Canada, Report of the Federal-Provincial Advisory Committee on Environmental and Occupation Health, 1995; and,
- “Field Guide for the Determination of Biological Contaminants in Environmental Samples”, and American Industrial Hygiene Association (AIHA), 1996.

5.9 Radioactive Materials

The following regulations govern the use of radioactive materials;

- Radiation Protection Regulations (SOR/2000-203P); and
- Nuclear Substances and Radiation Devices Regulations (SOR/2000-207).



5.10 Fuels, Oil and Waste Oil Storage

The following regulations govern the use of fuels, oil and waste oil storage;

- National Fire Code, 1995 a. 2002
- Technical Standards and Safety Act, 2000 (S.O. 2000, c. 16) a. S.O. 2001, c.9
- Liquid Fuels Handling Regulation (O. Reg. 217/01) and associated code (formerly Gasoline Handling Act and Code)
- Fuel Oil Regulation (O. Reg. 213/01)
- Installation Code for Oil Burning Equipment B139-00 (April 2000)
- Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands Regulations (SOR/97-10) a. SOR/2000-105
- Technical Guidelines for Aboveground Storage Tank Systems Containing Petroleum Products (P.C. 1996-1233)
- Technical Guideline for Underground Storage Tank Systems Containing Petroleum and Allied Products
- Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products, 2003 CCME

5.11 Hazardous Materials Storage

The following regulations govern the storage of hazardous materials;

- Canadian Environmental Protection Act (CEPA) - Regulation for the Management of Hazardous Wastes at Federal Facilities regulates toxic substances and outlines regulations for hazardous waste management
- The National Fire Code of Canada sets technical requirements for the storage and handling of flammable and combustible liquids to prevent fires or explosions.
- Canada Labour Code sets general requirements for the protection of worker health and safety.
- Workplace Hazardous Materials Information System (WHMIS) System deals with the identification of controlled products and their hazards.



- Occupational Health and Safety Regulations, Part X - Hazardous Substances outlines education, storage, handling and general requirements for hazardous substances use, including WHMIS requirements.

6.0 SURVEY RESULTS AND DISCUSSION

The results of the survey for designated substances are discussed below. Refer to **Appendix 1** for background information on designated substances and to **Appendix 16** for definitions of terminology used in this report.

6.1 Acrylonitrile

Acrylonitrile may be present in stable form in paints and adhesives. The presence of this compound in these forms is not expected to be of concern during building renovation or demolition.

6.2 Arsenic

Arsenic or arsenic compounds may be present in paints and adhesives. During demolition or renovation activities, the management of arsenic in paint would be addressed following the precautions for lead paint abatement (if required).

6.3 Asbestos

Asbestos-containing materials (ACMs) are grouped into two classifications, friable and non-friable materials. Friable ACMs are those that can easily be crumbled or broken apart by mere hand pressure. When these materials break apart asbestos fibres are then released into the atmosphere. Non-friable ACMs or "*manufactured products*" are materials that by the nature of their manufacturing/construction do not readily allow the release of asbestos fibres. These materials should not be cut or shaped with power tools, since this procedure may allow for the release of the asbestos fibres.

Friable ACMs were used as building materials up to and including 1986, while non-friable ACMs are still available today. Regulation 838 of the Revised Regulations of Ontario, 1990 (RRO 838/90) requires that an Asbestos Operations and Maintenance Program (O&M) be implemented in buildings that have been identified to contain friable ACMs. An O&M is not required for buildings that



contain only non-friable ACMs. However, in the Regulation, work procedures are prescribed for non-friable ACMs and for this reason they have been included in the survey.

Jacques Whitford conducted an asbestos building materials survey as part of the Designated Substances Survey in the subject facility. A summary list of the bulk samples that were collected during the survey including a description of the material, sampling location, type of analysis and laboratory test results is provided in **Appendix 4**. A copy of the laboratory Certificates of Analysis for asbestos testing are provided in **Appendix 13**.

6.3.1 Friable Asbestos-Containing Materials

During the site reconnaissance, friable ACMs were not identified to be present in the subject buildings.

6.3.2 Non-Friable Asbestos-Containing Materials

Non-friable ACMs were not identified to be present in the subject buildings during the site reconnaissance.

Roofing Materials

Roofing materials have been known to contain asbestos. The following common roofing products may contain asbestos: shingles; felts; flashing; underlayment; vapour retardants; mastics; adhesives; coatings; sealants; and, decking. In order to avoid damaging the integrity of the roofs of the various buildings at the subject facility and potentially voiding any warranties that may be in place, Jacques Whitford did not undertake the sampling of roofing materials. Roofing materials at this facility are not likely to contain asbestos based on the facility date of construction (1996).

6.4 Benzene

Benzene as a constituent of gasoline is present in a stable form in roofing materials, paints and adhesives. Benzene in these forms is not expected to be of a worker exposure concern during building renovation or demolition.



6.5 Coke Oven Emissions

Based on the history of the subject building, it is not suspected that coke oven emissions are of concern.

6.6 Ethylene Oxides

Ethylene oxide was not identified in the buildings assessed.

6.7 Isocyanate

No isocyanate compounds were noted to be stored or used within the buildings assessed; however, these compounds may be present in paint finishes.

6.8 Lead

Six samples of major paint applications were collected in the form of paint chip samples and submitted to PASC for lead content analysis. The results of the testing of the paint chip samples, along with sampling locations are summarized in **Appendix 6**.

The results of the laboratory testing indicate that lead was not identified to be present in excess of the MOL criteria of 5,000 ppm. The laboratory results for major paint applications sampled indicated a lead content below 20 ppm.

Although unlikely, lead may also be present in the following materials that may be found at the subject facilities:

- solder used on domestic water lines;
- solder used in bell fittings for cast iron pipes;
- solder used in electrical equipment;
- ceramic tile glaze; and,
- vent and pipe flashings.



6.9 Mercury

A room-by-room summary in the subject areas of all occurrences of mercury-containing equipment is provided in **Appendix 8**.

Liquid mercury-containing devices were not identified to be present at the subject facility.

Mercury vapour may be present in the fluorescent light tubes (approximate count of 1,000 tubes), fluorescent bulbs (approximate count of 50 bulbs), and high intensity discharge (HID) vapour bulbs (approximate count of 300) identified to be present throughout the buildings.

Mercury is also known to have been used in latex paints and adhesives as an anti-mildew and antibacterial agent and fungicide. Oil-based paints are not known to contain mercury.

6.10 Silica

Generally, silica is expected to be present in concrete, brick, mortar, ceramic tiles and ceiling tiles that constitute the building materials used at the facility.

6.11 Vinyl Chloride

Generally, vinyl chloride (monomer) is likely to be present in stable form within the PVC piping and conduits, where applicable.

6.12 Polychlorinated Biphenyls (PCBs)

The use of PCBs in electrical equipment such as transformers and capacitors, including capacitors found in fluorescent lamp ballasts, was common up to 1980. The Federal Chlorobiphenyls Regulation, SOR/91-152, and Ontario Regulation 362 under the Environmental Protection Act, prohibits the use of PCBs in electrical equipment installed after July 1, 1980.

Lamp Ballasts

Only one type of fluorescent light ballast was encountered at the site. This ballast was manufactured by Flotronic Technology (Model # 347V-T8-RS). All of the ballasts that were inspected were clearly marked as "no PCBs".



Main Power Transformer – Dielectric Fluid

Transformers were identified to be present the north west corner of GVE01; north east corner of GVE07; the mechanical penthouse of Area D; and, the mechanical room (B123). These transformers are of the dry type and do not contain a dielectric fluid, therefore PCBs are not a concern.

6.13 Ozone-Depleting Substances (ODS)

An area-by-area summary of all occurrences of ODS-containing equipment is provided in **Appendix 10**.

Ozone Depleting Substances were identified to be present in the various and numerous pieces of refrigeration and air conditioning equipment present throughout site including rooftop equipment.

Mr. Cd, Administrative Planning Manager of Mitsubishi Electric Sales Canada Inc. provided information regarding refrigerant used in the air conditioning units located in the second floor classrooms of C wing. All air conditioning units were identified by Mr Cd to have been factory charged with R-22, an ozone depleting substance.

6.14 Urea Formaldehyde Foam Insulation (UFFI)

No UFFI was noted to be present at the subject facility.

6.15 Mould

An area-by-area summary of all occurrences of visually identified mould and water damage is provided in **Appendix 11**.

Water damage was observed in Dwelling Units E1 to E4, and E7 to E9. Water infiltration is suspected to be the source of a bulge in the drywall of the second floor hall of Dwelling Unit E8.

Suspected mould growth was observed on the caulking of bathtubs in Dwelling Units E4 and E7.

6.16 Radioactive Materials

An x-ray inspection system was present at the main entrance to the facility (B102). The system was

manufactured by AMSCAN in March 1997 and used to inspect baggage entering the facility. A maintenance log with operating instructions was located with the unit. Mr. Joe Ashton of Adga Group, who performs the electronic maintenance of the system, was unable to provide information regarding radiation source or quantities.

A dental x-ray system was present in the dental office (C113). The system was manufactured by De Gotzen S.R.L. Legnano and used for dental radiography. A nameplate was not located and equipment documentation was not observed to be present in the vicinity of the system. These x-ray systems have been reportedly known to have incomplete specifications and labelling on equipment manufactured for Dentx based on information provided by the manufacturer (<http://www.recalls.org/3-00.html>).

6.17 Fuels, Oil and Waste Oil Storage

Two diesel fuel storage tanks are located on the property. They are the fuel supply for the backup generator. One double-walled aboveground storage tank (2200 L) is located outside the maintenance building and the second aboveground storage tank (day tank) (908 L) is located inside the maintenance building within a secondary containment system.

Jerry cans of petroleum fuels, oils and lubricants were noted to be stored in the Garbage/Compact/Recycling Building (GVG01) without secondary containment.

6.18 Hazardous Materials Storage

An area-by-area inventory of hazardous materials stored at the facility is provided in **Appendix 12**.

The hazardous materials observed to be present at the time of the site reconnaissance consisted predominantly of various cleaners, paints and small quantities of insecticide. Hazardous materials no longer in use were stored in various locations, for example, Main Building Basement Boiler Room and Maximum Security Area.

WHMIS based labelling was not observed to be present on all storage containers and Material Safety Data Sheets (MSDS) were not readily available for products that were identified and many were out of date.

Propane Cylinders are kept in a locked propane cage by the Maintenance shed. Signage identifying



the storage area and a "No Smoking" sign were missing.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations based on the results of this survey are provided in the following sections for each designated substance and hazardous material.

7.1 Acrylonitrile

Acrylonitrile may be present in paints and adhesives. Follow lead recommendations for the management of this compound during renovation or demolition of the subject building.

7.2 Arsenic

Arsenic may be present in paints and adhesives. Follow lead recommendations for the management of this compound during renovation of the subject facility.

7.3 Asbestos

Asbestos-containing materials were not identified to be present at the subject facility. Should a material suspected to contain asbestos fibres become uncovered during renovation or demolition activities, all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if asbestos fibres are present. Confirmed asbestos materials should be handled in accordance with RRO 838/90.

7.4 Benzene

Benzene is likely present in stable form in paints and adhesives. No action is required with regard to the management of this compound in these forms during renovation work.

7.5 Coke Oven Emissions

Coke oven emissions were not identified in the subject building.



7.6 Ethylene Oxides

Ethylene oxides were not identified in the subject areas.

7.7 Isocyanate

Isocyanate may be present in paint finishes. Follow lead recommendations for the management of this compound during renovation or demolition of the subject facility.

7.8 Lead

Lead was not identified to be present in excess of the MOL criteria of 5,000 ppm, in sampled paint applications found on building surfaces throughout the facility.

During the removal of paints or other materials that may contain lead, airborne lead dust or fumes should not exceed the MOL Time Weighted Average Exposure Value (TWAEV) of 0.05 milligram per cubic metre (mg/m^3).

Construction or renovation work that may disturb lead-containing materials should follow the recommendations provided in the document entitled "Draft Guideline: Lead on Construction Projects", issued by the Ministry of Labour on December 5th, 2002.

7.9 Mercury

Mercury or mercury vapours within light fixtures poses no risk to workers or occupants provided the mercury containers remain intact and undisturbed. Prior to demolition, the light tubes must be removed and stored in a safe, secure location or disposed of following the requirements of RRO 844/90.

7.10 Silica

Precautions should be taken as required during demolition and renovation projects on concrete (i.e. coring through concrete slabs, demolition of masonry or concrete units) to ensure that workers' exposure levels to silica does not exceed $0.05\text{mg}/\text{m}^3$. This can be achieved by:

- providing workers with respiratory protection;



- wetting the surface of the materials to prevent dust emissions; and,
- providing workers with facilities to properly wash prior to exiting the work area.

Work that may disturb silica-containing materials should follow the recommendations provided in the document entitled "Draft Guideline: Silica on Construction Projects", issued by the Ministry of Labour on December 5th, 2002.

7.11 Vinyl Chloride

Vinyl chloride is likely present in stable form in pipes, conduits and interior finishes. No action required.

7.12 Polychlorinated Biphenyls (PCBs)

PCBs were not identified to be present at the subject facility.

7.13 Ozone-Depleting Substances

The ozone-depleting substances identified to be present in the subject buildings should be removed by a licenced contractor prior to demolition of the subject building. When removing the refrigeration and cooling equipment, the refrigerants should be handled such that there is no release of ODS into the atmosphere and in accordance with applicable regulations.

Units containing R12 should have the refrigerant removed in accordance with applicable regulations.

Units containing R22 should have the refrigerant removed when such units are decommissioned.

7.14 Urea Formaldehyde Foam Insulation

Urea formaldehyde foam insulation was not identified to be present in the subject building.

7.15 Mould

Consideration should be given to conducting an intrusive mould investigation at locations where water damage or damage to caulking was identified.



Areas of the facility identified to contain dark staining should be remediated and the source of moisture eliminated.

7.16 Radioactive Materials

Equipment containing radioactive materials should be maintained in accordance with the manufacturer's specifications and in compliance with applicable regulations.

7.17 Fuels, Oil and Waste Oil Storage

The facility does not have large quantity of POLs but those that are present require some improvements. The diesel fuel AST located outside requires content identification of lines by way of markings [National Fire Code], detailed plans for piping systems [National Fire Code] and comprehensive annual inspections [CCME].

Jerry cans of petroleum fuels, oils and lubricants are stored in the Garbage/Compact/Recycling Building (GYG01) without secondary containment that should be installed around the containers storing POLs.

Additional recommendations with respect to training and spill response plans are provided in Jacques Whitford's compliance audit report entitled "Environmental Condition and Operations Audit, Grand Valley Institution for Women AERP, Correctional Services of Canada", dated March 26, 2004 for Public Works and Government Services Canada.

7.18 Hazardous Materials Storage

Inventories of areas where hazardous materials are stored should be posted at each storage area.

Hazardous materials no longer in use should be disposed of in accordance with applicable regulations.

Material Safety Data Sheets should be readily available and current.

Products should be labelled in accordance with WHMIS requirements.

Propane cylinders kept in the locked propane cage by the Maintenance shed should have appropriate



signage including a “No Smoking” sign.

Additional recommendations with respect to the handling and labelling of hazardous products are provided in Jacques Whitford’s compliance audit report entitled “Environmental Condition and Operations Audit, Grand Valley Institution for Women AERP, Correctional Services of Canada”, dated March 26, 2004 for Public Works and Government Services Canada.

8.0 OPINION OF PROBABLE COST FOR REMEDIAL ACTION

An opinion of the probable cost associated with the management of designated substances and hazardous materials identified at the subject facility is presented in Table 3 below. The cost is based on the complete management of these materials in order to facilitate building demolition or renovation.

Table 3 – Opinion of Probable Cost for Management of Designated/Hazardous Substances		
Designated Substance/ Hazardous Material	Comments	Cost
Acrylonitrile	no remediation required	na
Arsenic	no remediation required	na
Asbestos	no remediation required	na
Benzene	no remediation required	na
Coke Oven Emissions	no remediation required	na
Ethylene Oxides	no remediation required	na
Isocyanates	no remediation required	na
Lead	control measures during demolition or renovation activities (i.e. dust suppression measures, personal protective equipment)	\$2,000
Mercury	fluorescent light tube disposal (based on an estimate of 1,000 tubes)	\$500
	fluorescent light bulb disposal (based on an estimate of 50 bulbs)	\$50
	high intensity discharge bulbs (based on an estimate of 300 bulbs)	\$500
Silica	control measures during demolition or renovation activities (i.e. dust suppression measures, personal protective equipment)	\$2,000
Vinyl Chloride	no remediation required	na
PCBs	no remediation required	na
ODS	labour to evacuate ODS from 12 R12 units ¹	\$2,500
	labour to evacuate ODS from 17 R22 units ¹	\$3,000

Table 3 – Opinion of Probable Cost for Management of Designated/Hazardous Substances		
Designated Substance/ Hazardous Material	Comments	Cost
Mould	intrusive mould investigation of 7 dwellings with water damage remediation of areas visually identified to have dark staining	\$6,000 \$7,500
Radioactive Materials	no remediation required	na
Hazardous Materials	no remediation required	na
Totals -		\$22,050
Notes: na – not applicable ¹ Jacques Whitford's opinion of probable cost associated with the evacuation of the ozone-depleting substances from the various cooling and refrigeration units is to be considered a rough estimate only. For a more precise cost estimate, it is recommended that a contractor specialized in handling heating, ventilation and cooling (HVAC) equipment be consulted. Due to the time constraints imposed on completing this report Jacques Whitford was not able to re-visit the facility with an HVAC contractor to refine our estimate.		

9.0 CLOSURE

This report has been prepared for the sole benefit of Public Works and Government Services Canada. The report may not be used by any other person or entity without the express written consent of Jacques Whitford Environment Limited and Public Works and Government Services Canada.

Any use which a third party makes of this report, or any reliance on decisions based on it, are the responsibility of such third parties. Jacques Whitford Environment Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgement of Jacques Whitford Environment Limited based on the data obtained from the work. The conclusions are based on the site conditions encountered by Jacques Whitford Environment Limited at the time the work was performed at the specific inspection and/or sampling locations, and can only be extrapolated to an



undefined limited area around these locations. The extent of the limited area depends on building construction and conditions, weather, building usage and other factors. Due to the nature of the investigation and the limited data available, Jacques Whitford Environment Limited cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

We trust that the above is satisfactory for your purposes at this time. Should you have any questions or concerns, or require additional information, please do not hesitate to contact the undersigned at your convenience.

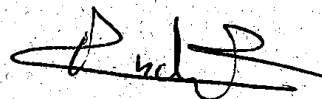
This report was prepared by David Stevens and reviewed by Andy Andriotis, P.Eng.

Sincerely,

JACQUES WHITFORD ENVIRONMENT LIMITED



David Stevens
Senior Field Technician



Andy Andriotis, P. Eng.
Project Manager



APPENDIX 1

**DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS
BACKGROUND INFORMATION**



Designated Substances

Acrylonitrile

Acrylonitrile is a clear liquid that may be colourless or yellow and that readily reacts with other chemicals to produce long, chain-like molecules (polymers). Acrylonitrile-based polymers are used to produce nitrile rubbers, plastics, acrylic fibres, coatings and adhesives. Workers are typically exposed to acrylonitrile at manufacturing facilities that produce the aforementioned products through inhaling its vapour, direct skin contact, or through ingestion. Although acrylonitrile may be present in some of the building materials, including adhesives and coatings, the chemical will likely be bonded in the polymer form. Therefore, it is not expected that an adverse exposure to acrylonitrile will occur unless the building materials are heated to extreme temperatures. Acrylonitrile vapours may become released from the acrylonitrile-based polymers during a process where high temperatures are applied.

Arsenic

The presence of arsenic in the paint coating on interior and exterior finishes is possible. The comments concerning lead paint, discussed in Section 5.8, will address the potential arsenic emissions. As the painted surfaces will be handled as per the proposed lead regulation, it is not expected that arsenic concentrations in the air will exceed the maximum allowable time weighted average exposure value (TWA_{EV}) for a worker to arsenic (0.01 mg/m³).

Asbestos

Asbestos is typically found in plaster, mechanical insulation, gaskets, thermal insulation on pipes, refractory material, roofing felts, floor tiles, ceiling tiles and parging, heat resistant panels, incandescent light fixture reflector plates, and any other material requiring a high degree of durability or thermal resistance. The common use of potential friable (breakable by hand) asbestos-containing materials (ACMs) in construction ceased voluntarily in the mid-1970s; however, the spray application of asbestos-containing fireproofing was not prohibited until 1986.

The disturbance of ACMs on construction projects is governed by Regulation 838 of the Revised Regulations of Ontario (1990), as amended by RRO 510/92, formerly Regulation 654/85 - Regulation Respecting Asbestos on Construction Projects and in Building and Repair Operations. ACMs must be removed prior to any demolition or renovation that may potentially disturb the



asbestos materials.

The Revised Regulations of Ontario (1990), Regulation 347 - Waste Management Regulation requires the disposal of asbestos waste in a double sealed container, properly labelled and free of cuts, tears or punctures. The waste must be disposed of at a licensed waste Station which has been properly notified of the presence of asbestos waste.

The transport of asbestos waste to the disposal site is covered by the federal "Transportation of Dangerous Goods Act". Asbestos waste is to be handled by a licensed waste hauler.

Benzene

Historically, benzene has been produced as a by-product of coal gasification and metallurgical coke production in steel making. The light oil product from such processes contains benzene, toluene, ethyl benzene and xylene, and these components are separated by distillation. Today, most benzene is produced from the refining of petroleum.

Benzene has applications as a solvent in synthetic rubber manufacturing and processing, and in paints, varnishes, stains, adhesives, roofing materials and sealants. The use of benzene in tire and other rubber goods manufacturing and as a solvent and component of paints and adhesives has declined considerably as a result of concerns about workplace exposure. Nevertheless, it is often present in trace quantities in petroleum and aromatic solvents, some of which have replaced benzene in many uses. Benzene is also a minor component of gasolines sold in Canada.

The maximum allowable TWAEV for a worker to benzene is 3.2 mg/m^3 . Based on the age of the subject building, it is possible that benzene was present in the paints, adhesives and roofing materials used during the original construction of the subject building. However, over time, the benzene component typically volatilizes out of the paints, solvents and roofing bitumens and is released into the ambient air. Therefore, it is likely that only trace levels of benzene presently exist in these building materials. It is not expected that benzene emissions from any existing building materials on site will exceed the allowable TWAEV.

Coke Oven Emissions

Coke oven emissions are found in the exhaust from the burning process of coke.



Ethylene Oxides

Ethylene oxide is a common byproduct of fumigation or sterilization procedures.

Isocyanates

Isocyanates are a class of chemicals used in the manufacture of certain types of plastics, foams and roof insulation. The Isocyanate (-CNO) group reacts very readily with certain other types of molecules, a property responsible for the usefulness of Isocyanates in industry. Due to the high reactivity of the Isocyanate group, exposure to Isocyanates can result in primary irritation, sensitization and hypersensitivity reactions. The respiratory system, the eyes and the skin are the main areas affected by exposure. Isocyanates in their initial form are found as a vapour, a mist, or a dust which become airborne and then taken into the body. Once the Isocyanates are chemically bonded to other chemicals during manufacturing processes, the Isocyanates are not readily available to become airborne unless heated. Therefore, Isocyanate exposure is not expected to be a concern as long as the burning of plastics, foams, and insulation is not carried out.

Lead

The Ontario Ministry of Labour (MOL) draft Proposed Lead Regulation on Construction Projects, made under the Occupational Health and Safety Act, May 5, 1995, states that the removal of lead paint is not required unless work on these materials are likely to produce airborne lead dust or fumes, for example during welding, torch cutting, sanding and sand blasting. If these operations are likely to occur during building renovations or demolition, it is recommended that the removal of lead paint be carried out in accordance with procedures outlined in the proposed regulation.

Lead may be used in its pure metallic form or combined chemically with other elements to form lead compounds. Metallic lead is used to make products such as electric storage batteries, ammunition, lead solder, radiation shields, pipes, and sheaths for electric cables. Metallic lead is sometimes combined with other metals such as copper, tin and antimony as lead alloys for use in the manufacture of a variety of metal products.

Organic lead compounds contain a lead atom covalently bonded to carbon. Common examples of organic lead compounds include lead "soaps" such as lead oleates, high pressure lubricants, and anti-knock agents in gasoline.



Inorganic lead compounds (or lead salts) result when lead is combined with an element other than carbon. Examples are lead oxide, lead chromate, lead carbonate and lead nitrate. Inorganic lead compounds may occur as solids or in solutions, and are used in insecticides, pigments, paints, frits, glasses, plastics, and rubber compounds.

Lead may affect the health of workers if it is in a form that may be inhaled, ingested or absorbed through the skin. Lead dust consists of small, solid particles of metallic lead or lead compounds that are generated by sanding, grinding, polishing, and sawing operations. Lead fume is produced in significant amounts when solid lead or materials containing lead are heated to temperatures above 500° C, as in welding and flame cutting or burning.

In Canada, the past use of lead in both interior and exterior paint was extensive. In 1976, Canadian regulations limited the amount of lead in interior paint to 0.5% by weight. The Time Weighted Average Exposure Value (TWAEV) for exposure of a worker to lead is 0.05 mg/m³ (RRO 843/90). The Occupational Health and Safety exposure limits should not be exceeded.

Mercury

Mercury is commonly found in buildings with mercury vapour lighting, thermostats, thermometers, and electrical mercury switches.

Silica

Silica, also referred to as free crystalline silica, is found in concrete, cement, mortar, ceramic wall and floor tiles, stucco finishes and acoustic ceiling tiles. Prolonged exposure to, and inhalation of free crystalline silica, may result in respiratory disease known as silicosis, which is characterised by progressive fibrosis of the inner lung tissue and marked shortness of breath or impaired lung function. The maximum TWAEV for airborne Silica dust is 0.05 mg/m³.

Vinyl Chloride

Vinyl chloride is found in many applications in buildings such as plumbing pipes, protective coatings on insulated pipes and interior finishes (i.e., vinyl baseboard trim). Vinyl chlorides in the above materials are bound in a solid matrix and are unlikely to become airborne such that it would exceed the maximum allowable TWAEV of 2.6 mg/m³.



Hazardous Materials

Polychlorinated Biphenyls (PCBs)

PCBs are used as a coolant in electrical equipment such as transformers and capacitor in fluorescent lamps ballasts. The use of PCBs as a coolant was common up to 1980. The Federal Chlorobiphenyls Regulation, SOR/91-152, and Ontario Regulation 362, under the Environmental Protection Act, prohibits the use of PCBs in the above electrical equipment installed after July 1, 1980.

Ozone-Depleting Substances (ODS)

Ozone-depleting substances are chemical agents usually used in freezers and compressors for refrigeration. They have also been used as aerosol additives and in the production of foam insulation. The use of ODS is regulated in Ontario under the Environmental Protection Act (EPA), Part VI and in Regulation 356. The "Montreal Protocol" is an international effort to reduce the use of ODS's world wide.

Federal Halocarbon Regulations SOR/99-255 apply to federal land, aboriginal land and federal works and undertakings. The regulation prohibits the release of halocarbons contained in refrigeration systems, air conditioning systems, fire extinguishers (except to fight a fire that is not a fire caused for training purposes) or containers or equipment used in the re-use, recycling, reclamation or storage of a halocarbon.

The regulation also imposes restrictions on the servicing and dismantling, disposing of or decommissioning of any system containing halocarbons and requires the recovery of halocarbons into an appropriate container by a certified individual. The regulation also details an owner's record-keeping obligations.

Urea Formaldehyde Foam Insulation (UFFI)

Urea Formaldehyde Foam Insulation is foam plastic developed as an improved means of insulating difficult-to-reach wall cavities in buildings. It is made up of a mixture of urea-formaldehyde resin, a foaming agent and compressed air that cures when injected. Most installations occurred between 1977 and 1980. Its use was banned in 1980 by the Government of Canada, when concerns over



possible health considerations over the release of formaldehyde gas during the curing process were raised.

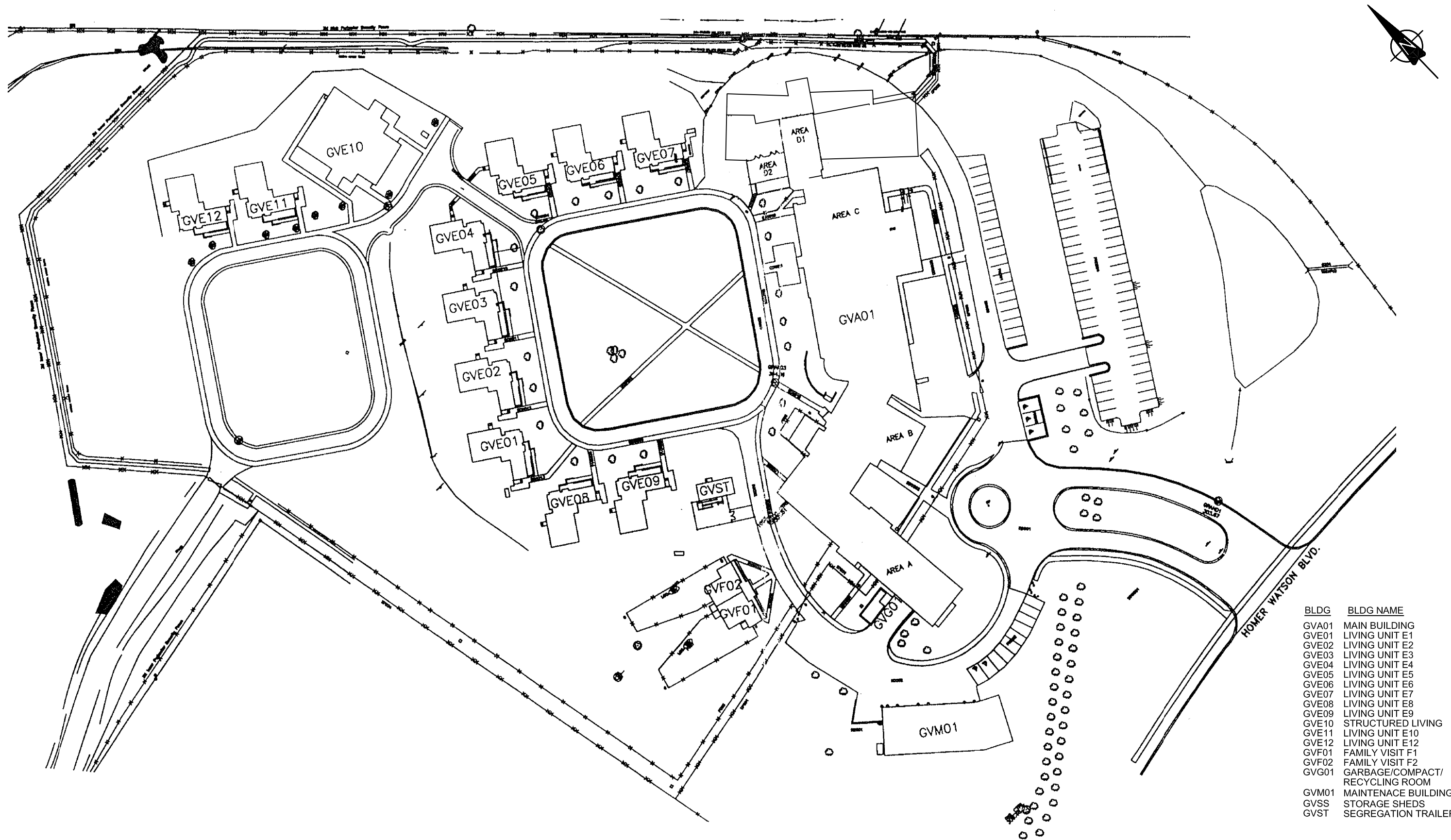
Tell tale signs of UFFI installation include evidence of small patched holes, two to seven centimetres in diameter that are usually spaced at regular intervals on exterior or interior walls. UFFI may also be visible around electrical outlets or switch plates.



APPENDIX 2

FACILITY SITE PLAN





BLDG	BLDG NAME
GVA01	MAIN BUILDING
GVE01	LIVING UNIT E1
GVE02	LIVING UNIT E2
GVE03	LIVING UNIT E3
GVE04	LIVING UNIT E4
GVE05	LIVING UNIT E5
GVE06	LIVING UNIT E6
GVE07	LIVING UNIT E7
GVE08	LIVING UNIT E8
GVE09	LIVING UNIT E9
GVE10	STRUCTURED LIVING
GVE11	LIVING UNIT E10
GVE12	LIVING UNIT E12
GVF01	FAMILY VISIT F1
GVF02	FAMILY VISIT F2
GVG01	GARBAGE/COMPACT/ RECYCLING ROOM
GVM01	MAINTENANCE BUILDING
GVSS	STORAGE SHEDS
GVST	SEGREGATION TRAILER

NOTE: LOCATIONS OF SITE FEATURES ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

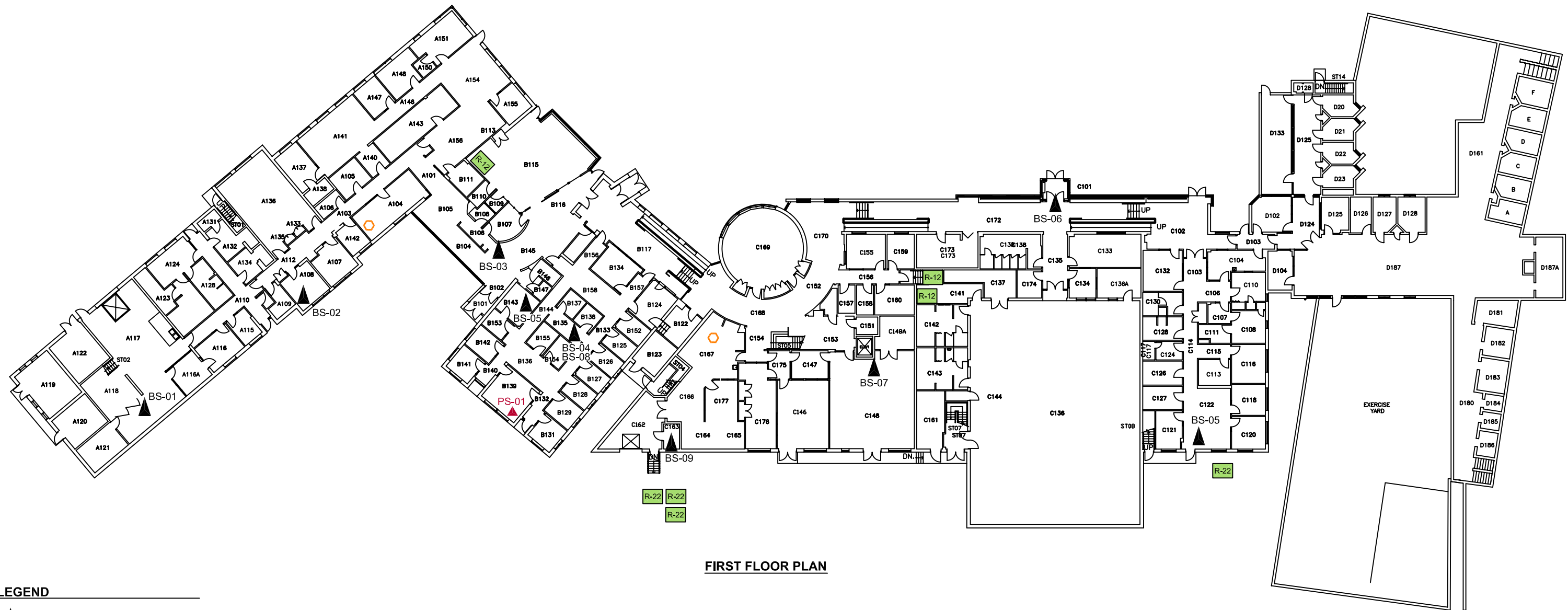
KEY PLAN
GRAND VALLEY INSTITUTION FOR WOMEN
 1575 HOMER WATSON BOULEVARD, KITCHENER, ONTARIO

Job No.:	ONT36539.2	Dwg. No.:	1
Date:	04/03/12	Dwn. by:	LMV LMV
		Appd.:	DS



APPENDIX 3

**FLOOR PLANS SHOWING THE LOCATIONS OF DESIGNATED
SUBSTANCES AND HAZARDOUS MATERIALS INCLUDING
SAMPLING LOCATIONS**



FIRST FLOOR PLAN

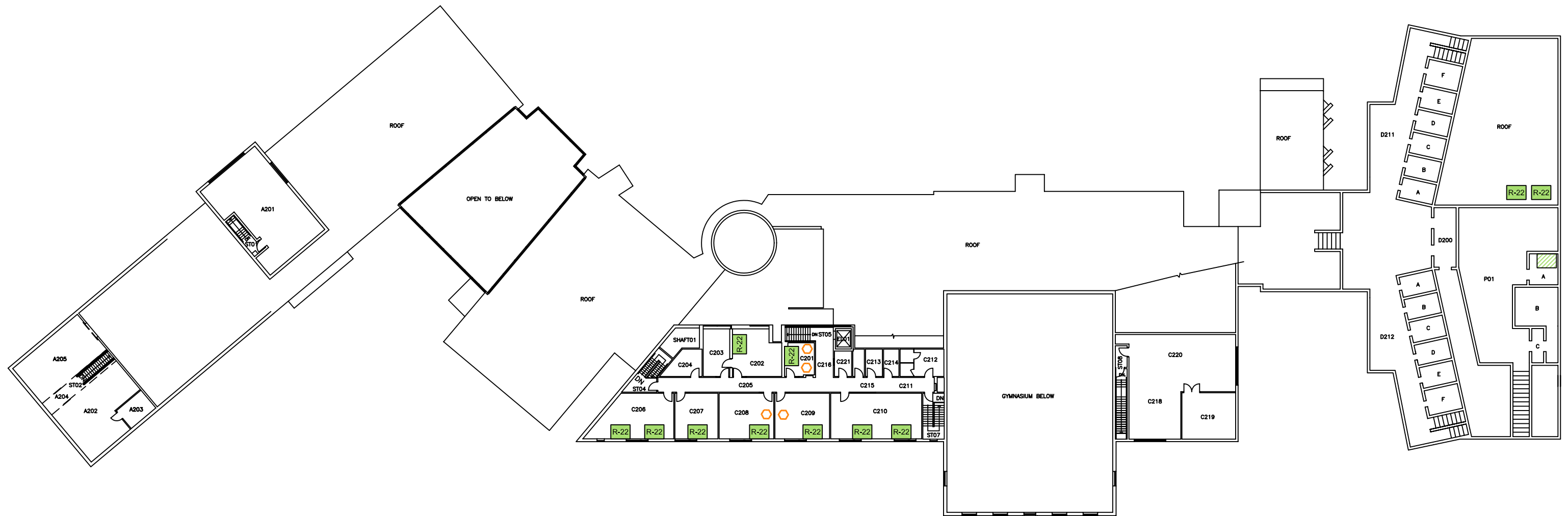
- LEGEND**
- ▲ BULK SAMPLE (ASBESTOS)
 - ▲ PAINT CHIP SAMPLE
 - INSPECTED LAMP BALLAST (NON-PCB CONTAINING)
 - EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.




FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD, KITCHENER, ONTARIO	Job No.:	ONT36539.2		Dwg. No.:	2	
	Date:	04/03/12		Dwn. by:	LMV LMV	
				Appd.:	DS	





GVA01 - MAIN BUILDING - SECOND FLOOR PLAN

LEGEND

-  INSPECTED LAMP BALLAST (NON-PCB CONTAINING)
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES
-  EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

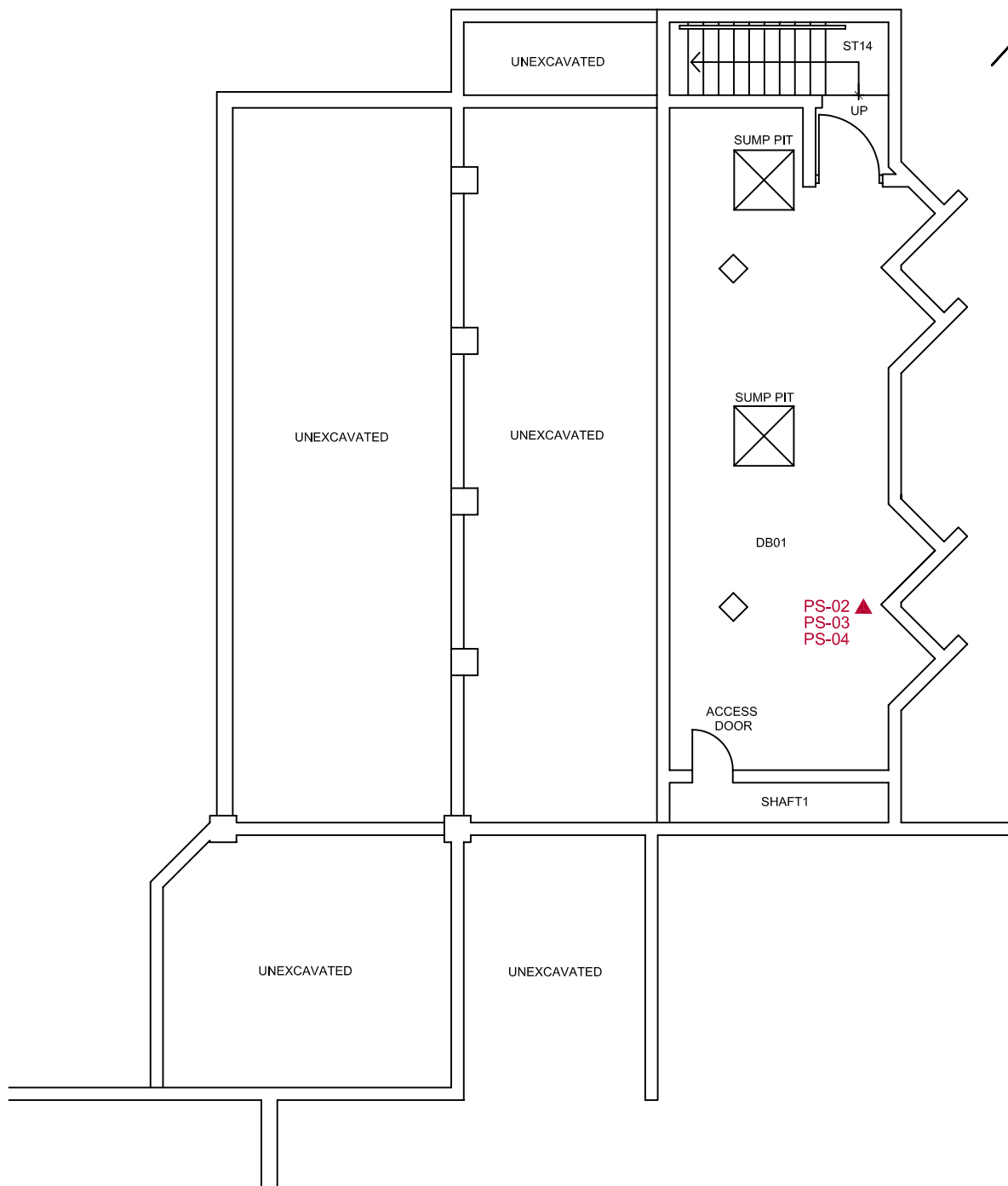
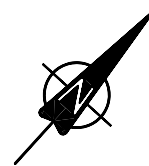
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD, KITCHENER, ONTARIO

Job No.: ONT36539.2		Dwg. No.: 3	
Date: 04/03/12	Dwn. by: LMV LMV	Appd.: DS	





GVA01 - MAIN BUILDING - AREA D2

LEGEND

▲ PAINT CHIP SAMPLE

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.:
ONT36539.2

Dwg. No.:
4

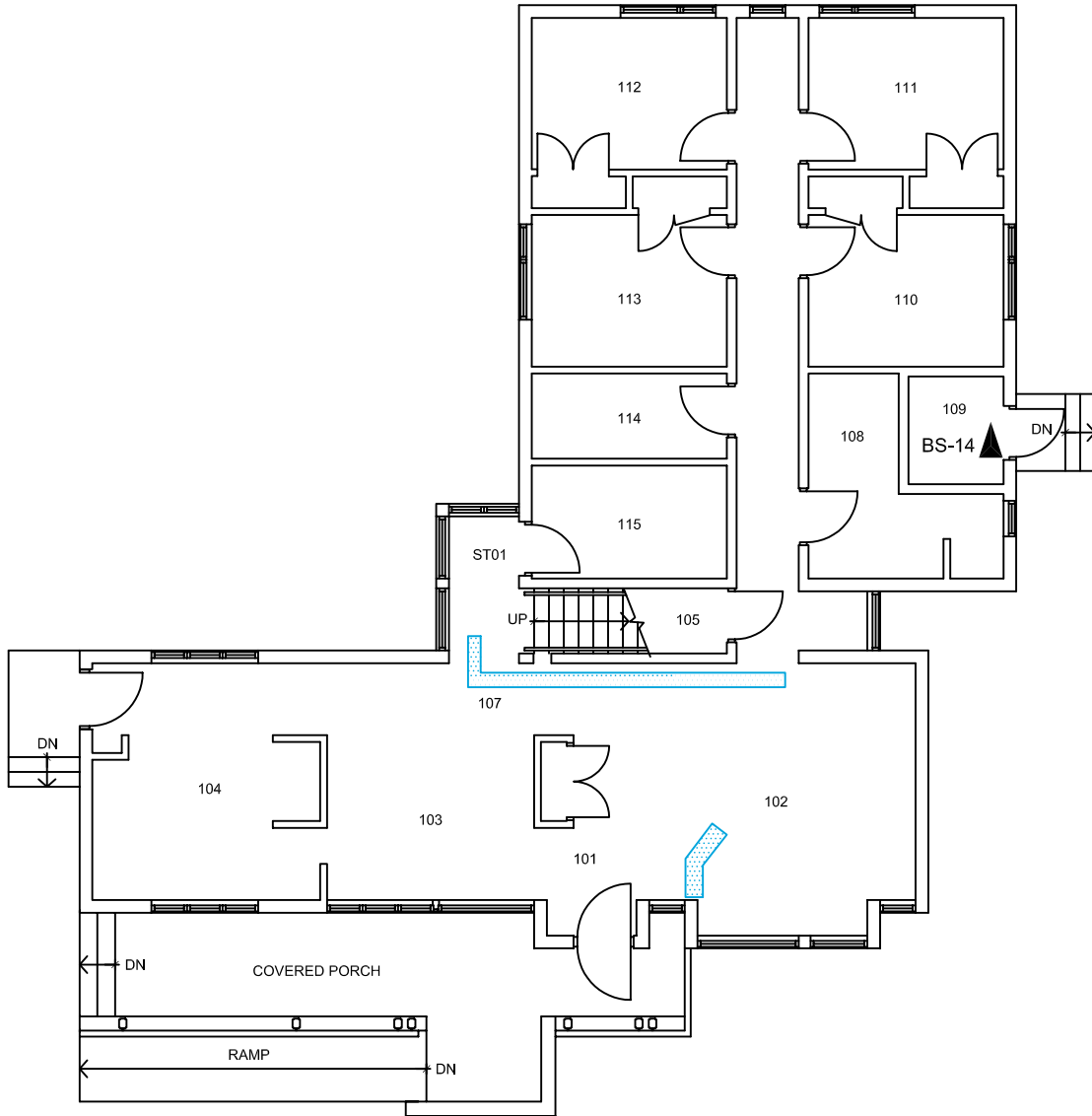
Date:
04/03/08

Dwn. by:
LMV LMV

Appd.:
DS





**Jacques
Whitford**



GVE01 - LIVING UNIT E1 - GROUND FLOOR

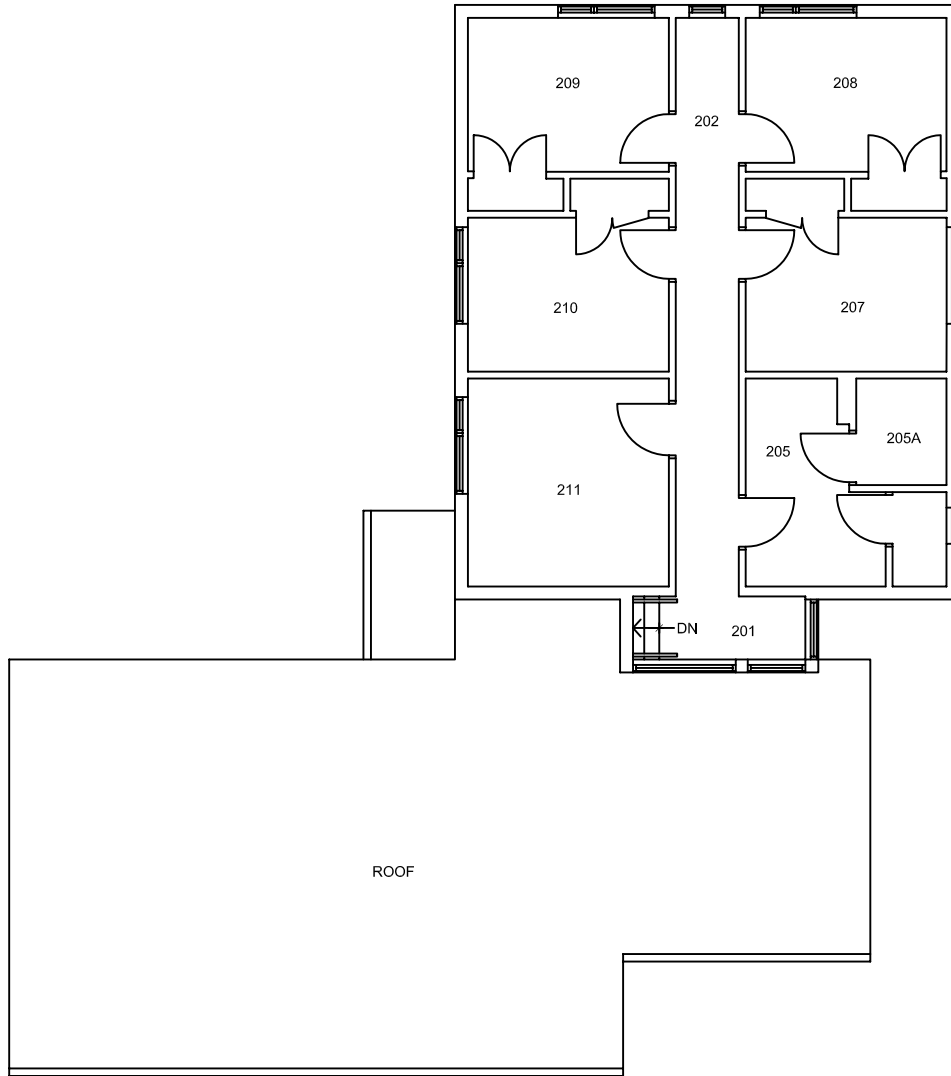
LEGEND

-  BULK SAMPLE (ASBESTOS)
-  EVIDENCE OF WATER DAMAGE

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	5	
Date:	Dwn. by:	Appd.:	
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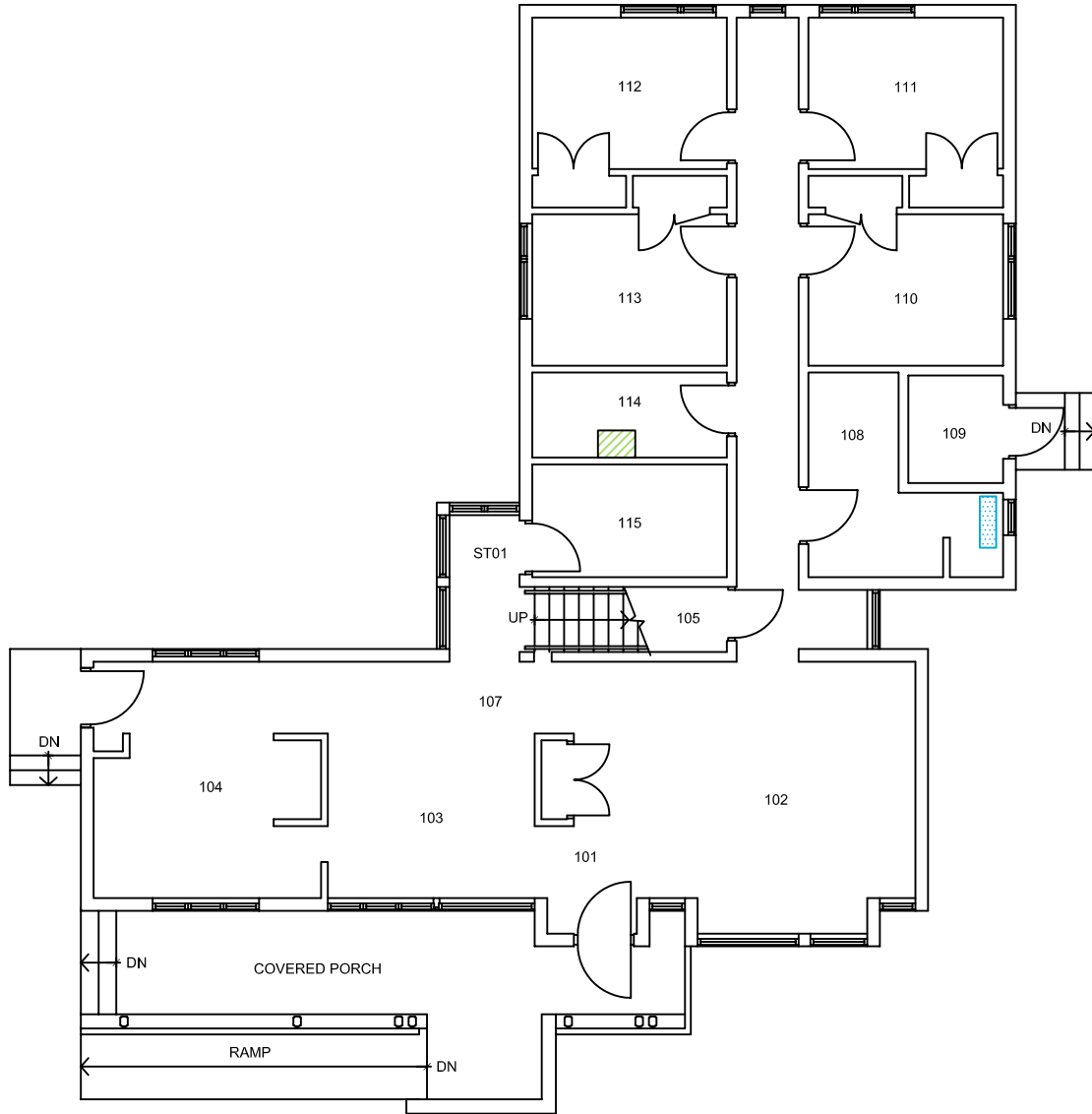


GVE01 - LIVING UNIT E1 - SECOND FLOOR

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.



N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	6	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE02 - LIVING UNIT E2 - GROUND FLOOR

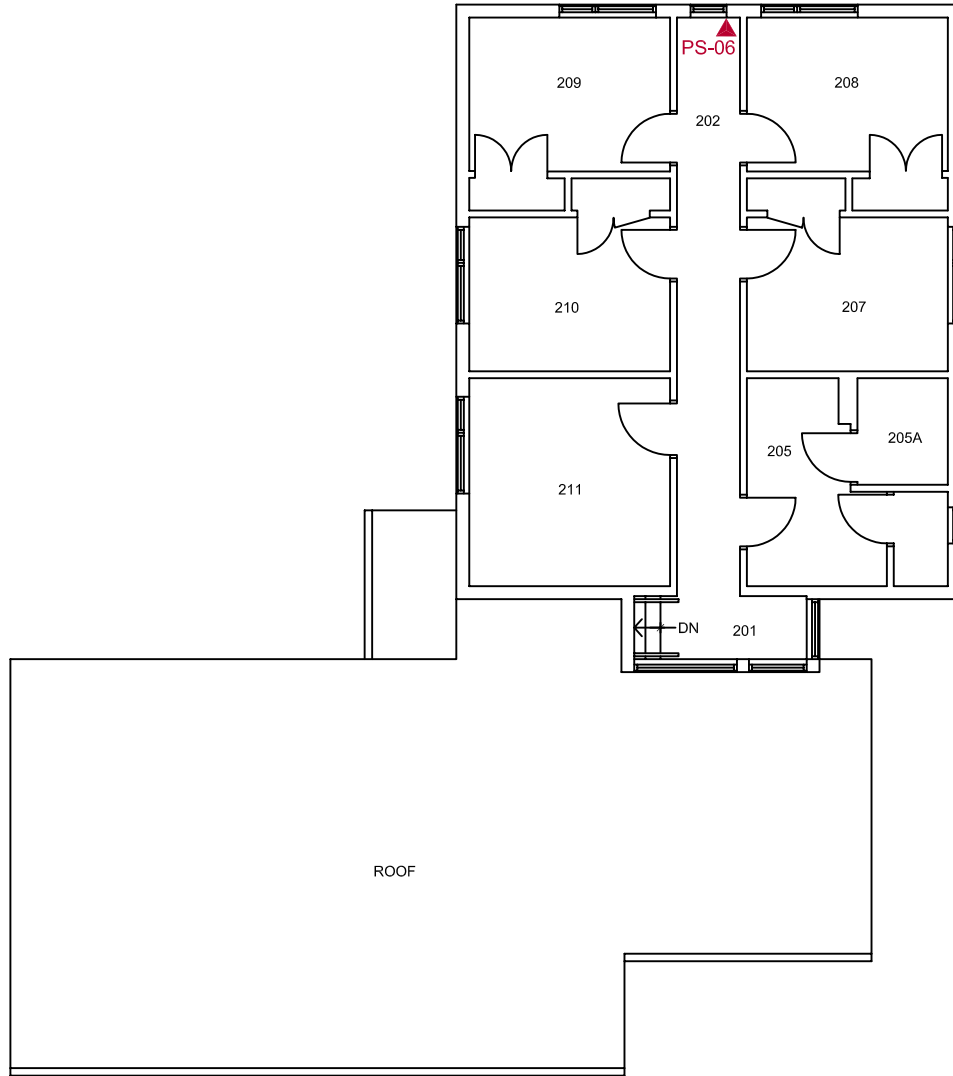
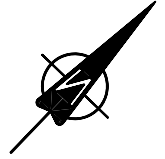
LEGEND

-  EVIDENCE OF WATER DAMAGE
-  EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	7	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE02 - LIVING UNIT E2 - SECOND FLOOR

LEGEND

▲ PAINT CHIP SAMPLE

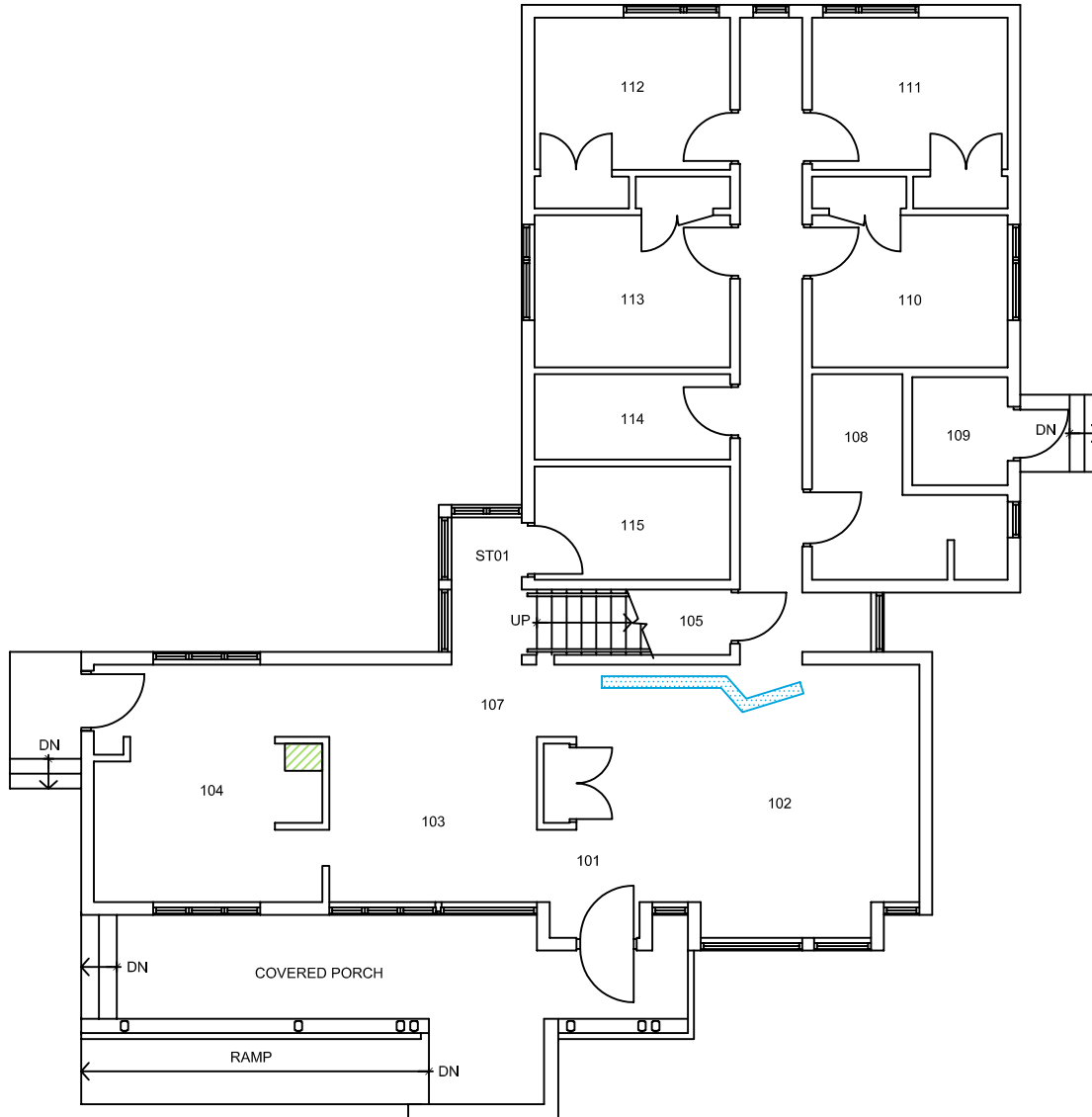
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**



Job No.: ONT36539.2		Dwg. No.: 8	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	





GVE03 - LIVING UNIT E3 - GROUND FLOOR

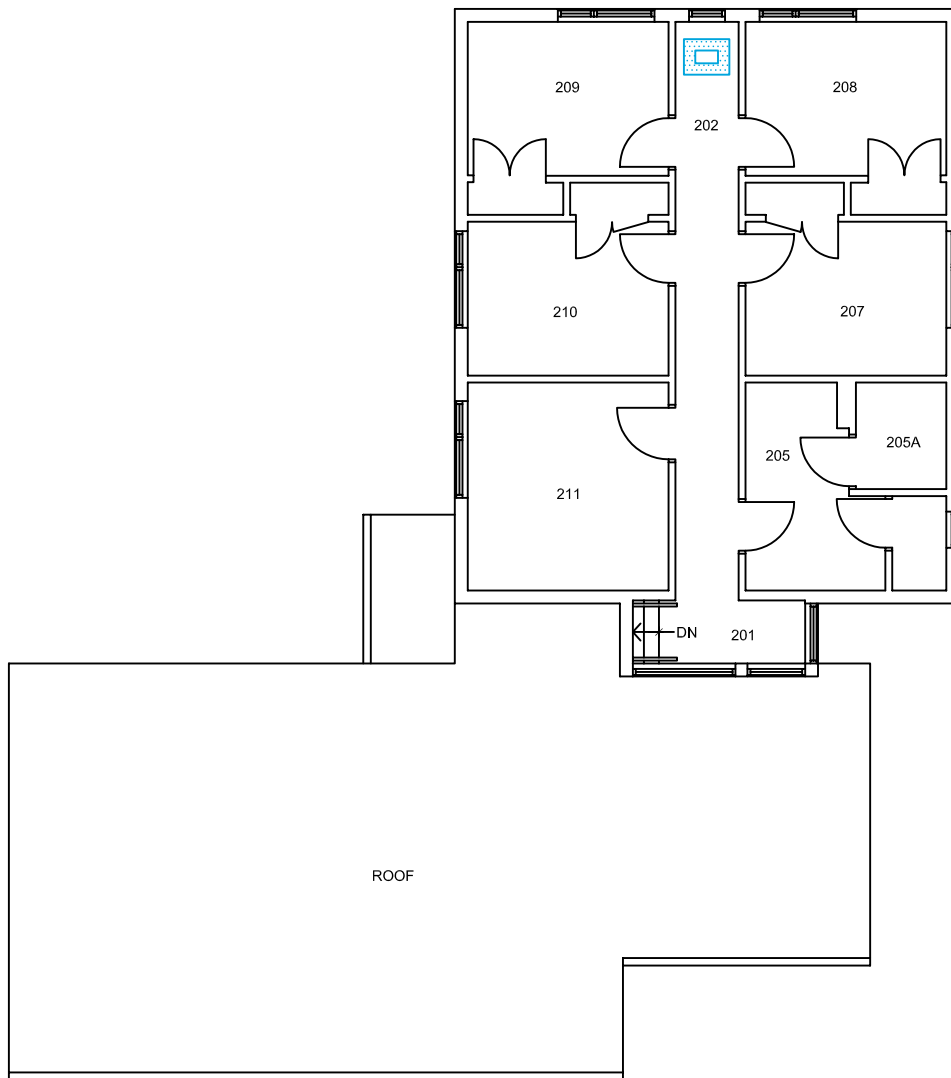
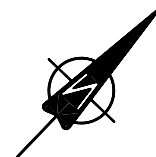
LEGEND

-  EVIDENCE OF WATER DAMAGE
-  EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	9	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE03 - LIVING UNIT E3 - SECOND FLOOR

LEGEND

 EVIDENCE OF WATER DAMAGE

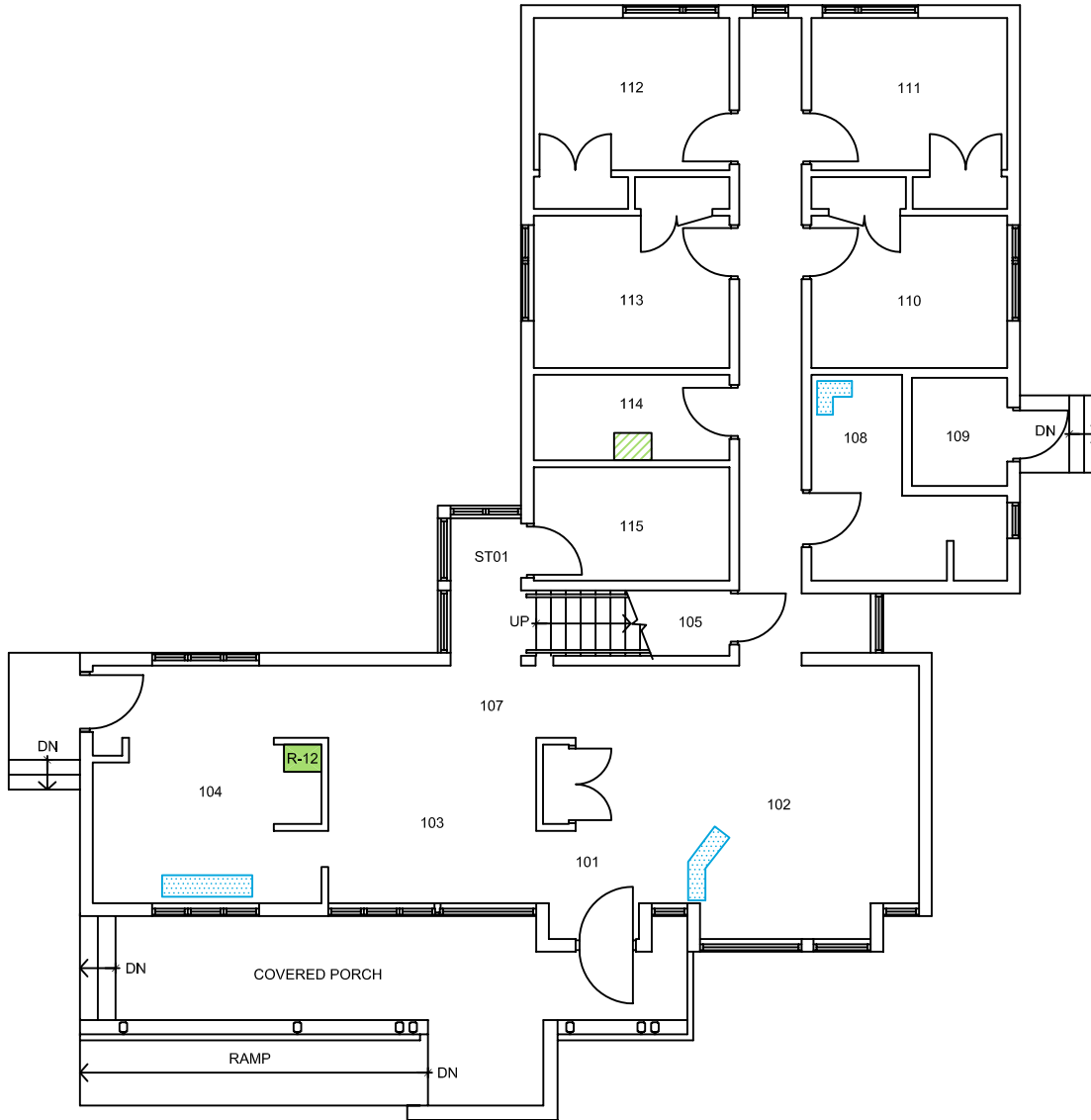
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**




Job No.: ONT36539.2		Dwg. No.: 10	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	





GVE04 - LIVING UNIT E4 - GROUND FLOOR

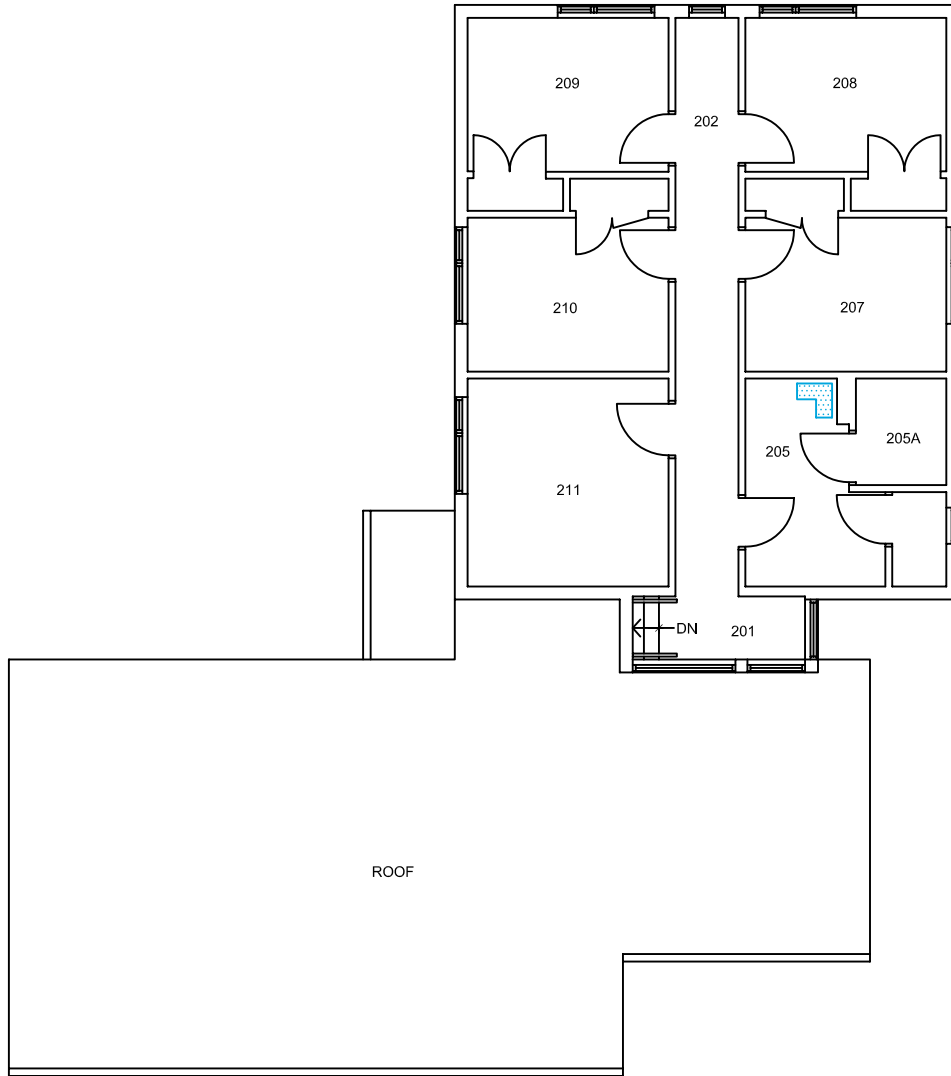
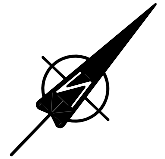
LEGEND

-  EVIDENCE OF WATER DAMAGE
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES
-  EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	11	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE04 - LIVING UNIT E4 - SECOND FLOOR

LEGEND

 EVIDENCE OF WATER DAMAGE

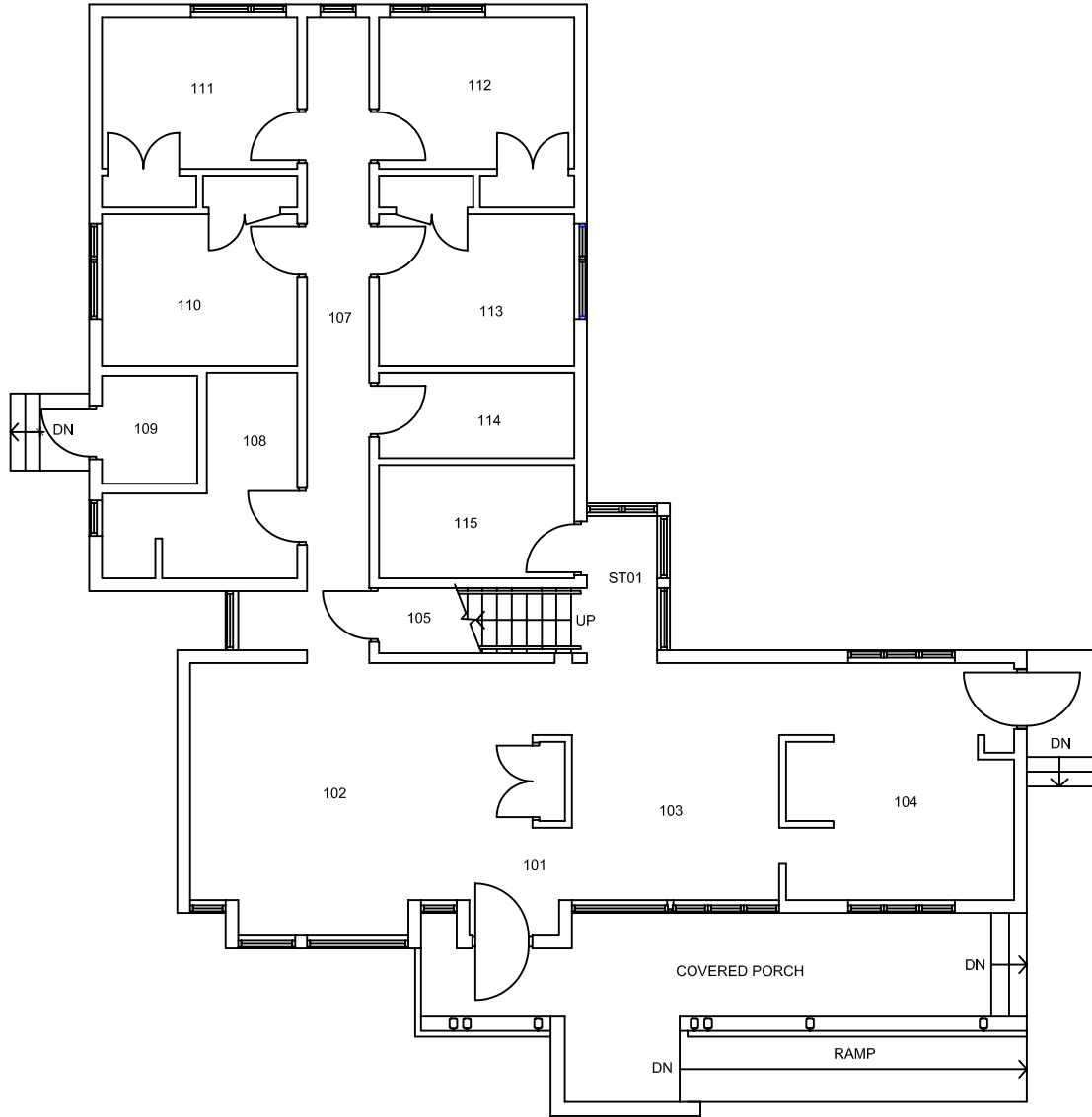
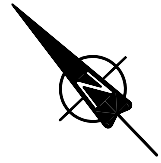
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 12	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	





GVE05 - LIVING UNIT E5 - GROUND FLOOR

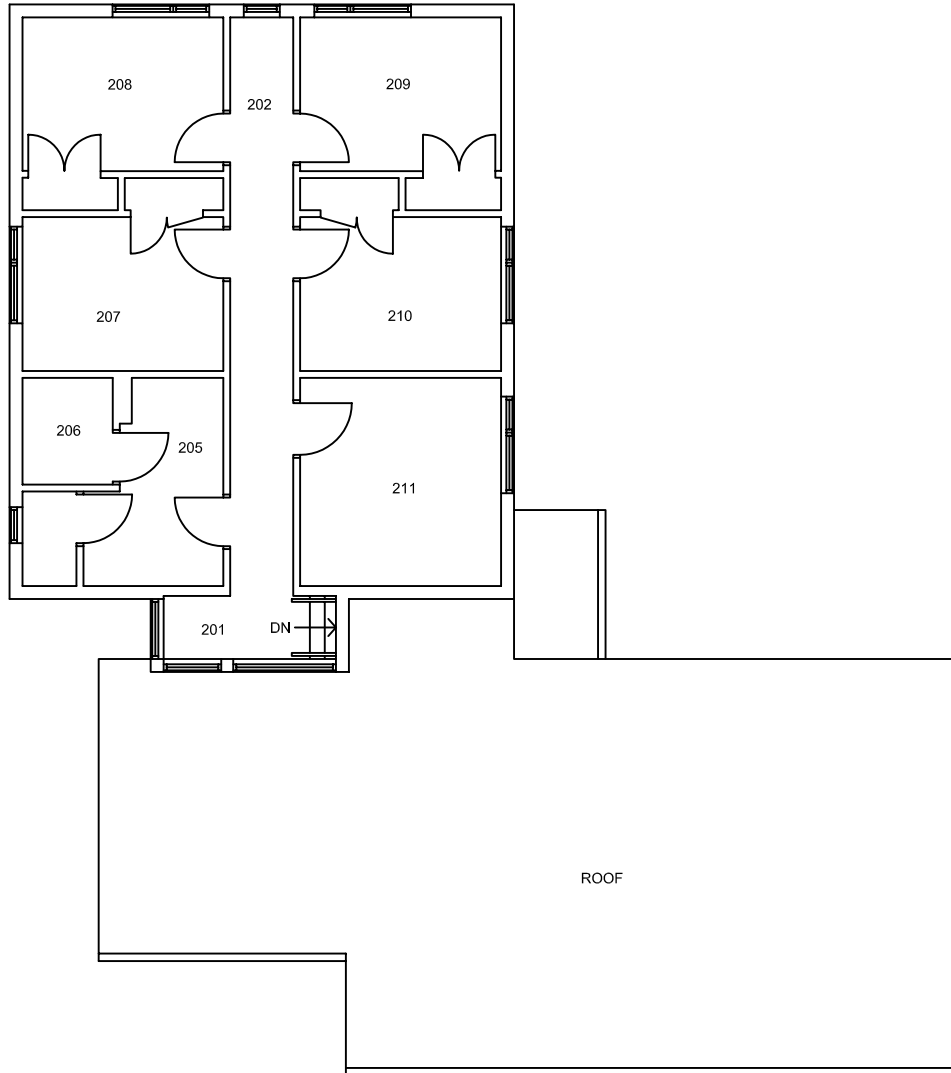
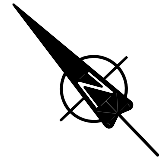
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 13	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



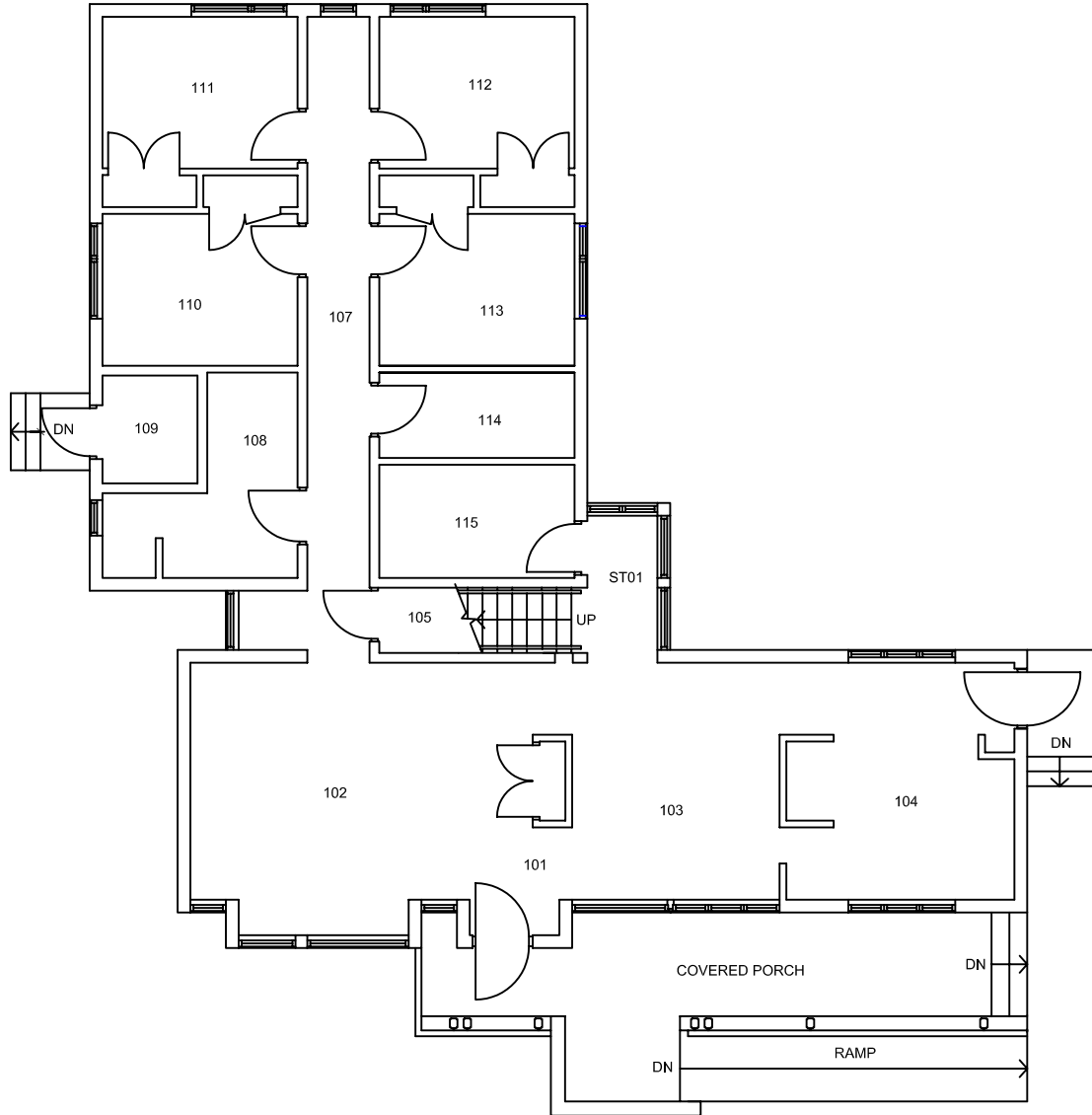


GVE05 - LIVING UNIT E5 - SECOND FLOOR

N. T. S.

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	Jacques Whitford
	ONT36539.2	14	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	

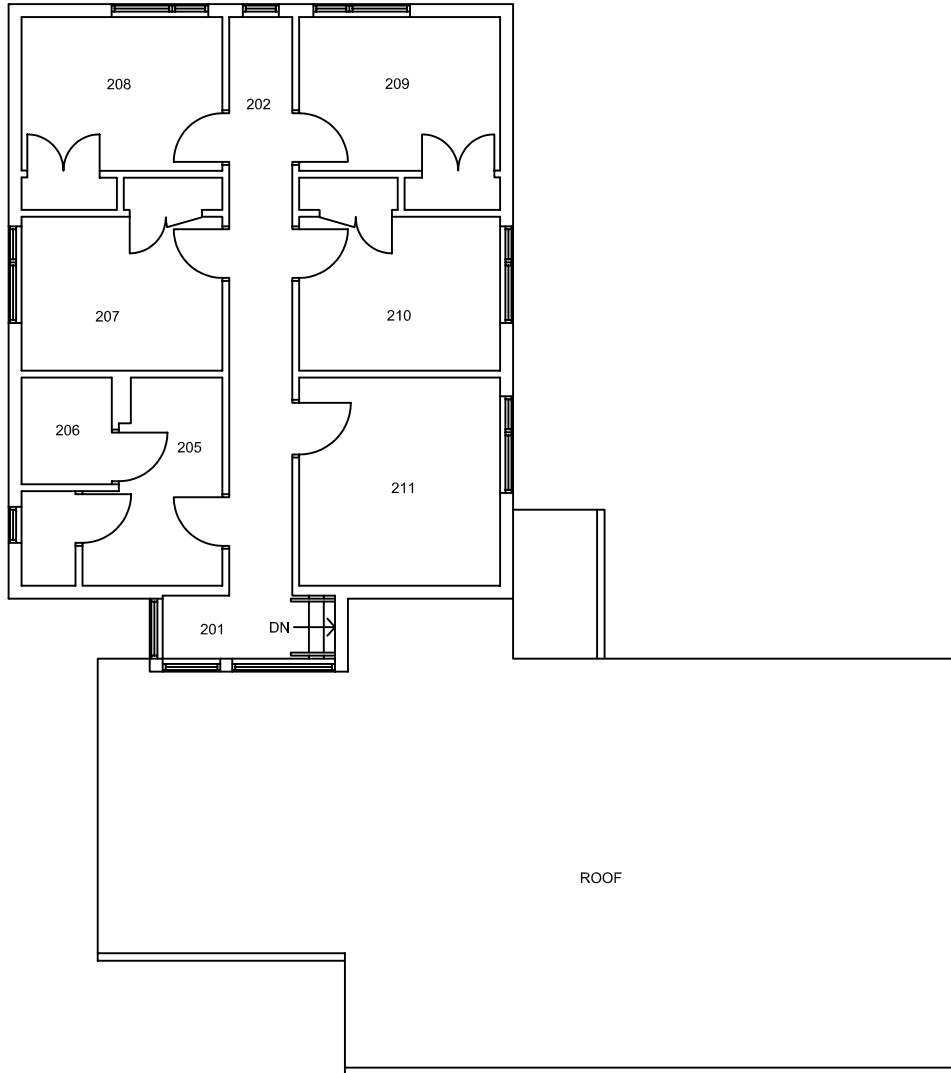
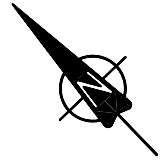


GVE06 - LIVING UNIT E6 - GROUND FLOOR

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

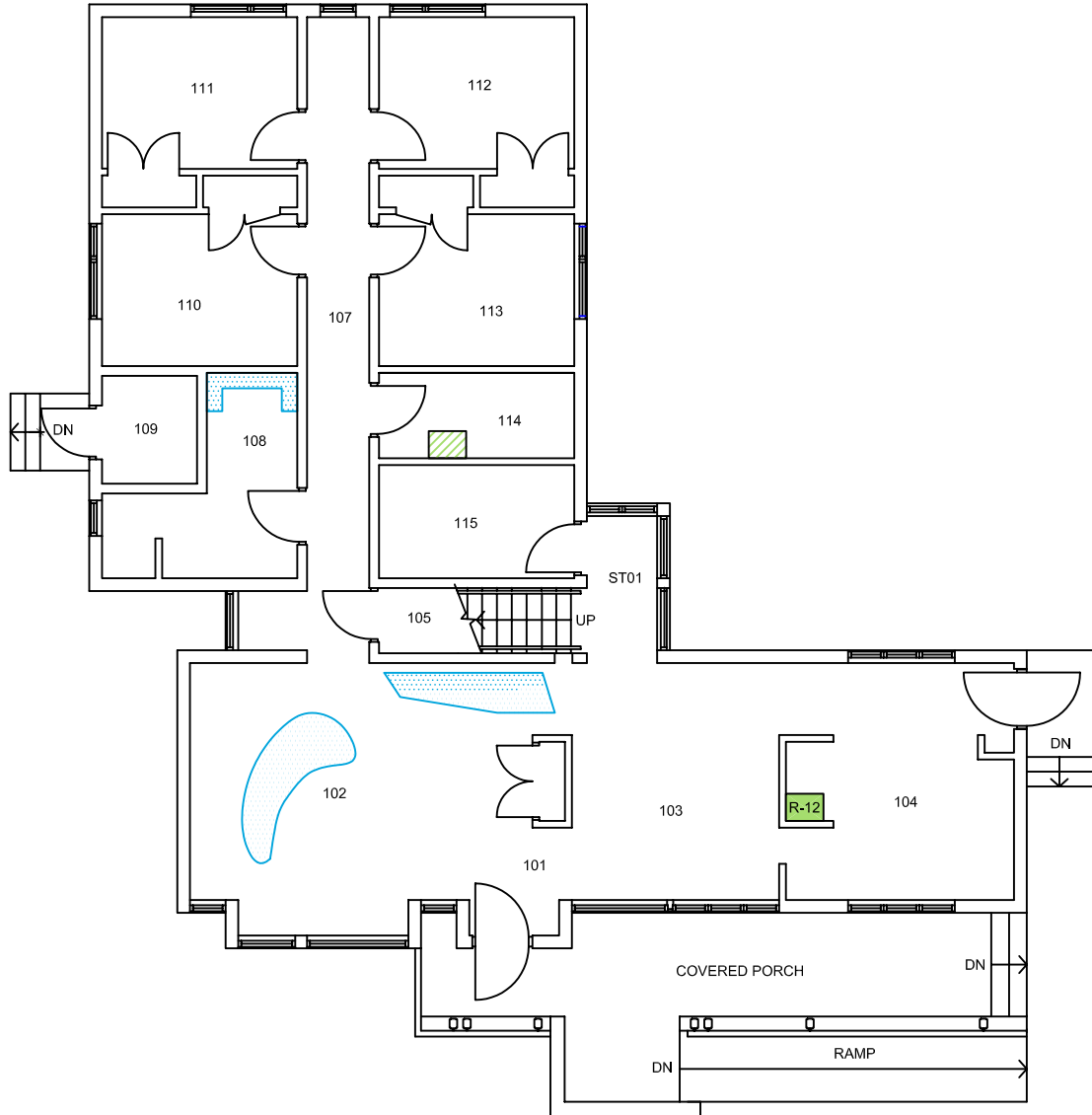
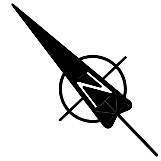
FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	15	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE06 - LIVING UNIT E6 - SECOND FLOOR




N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	16	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV <small>LMV</small>	DS	



GVE07 - LIVING UNIT E7 - GROUND FLOOR

LEGEND

-  EVIDENCE OF WATER DAMAGE
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES
-  EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

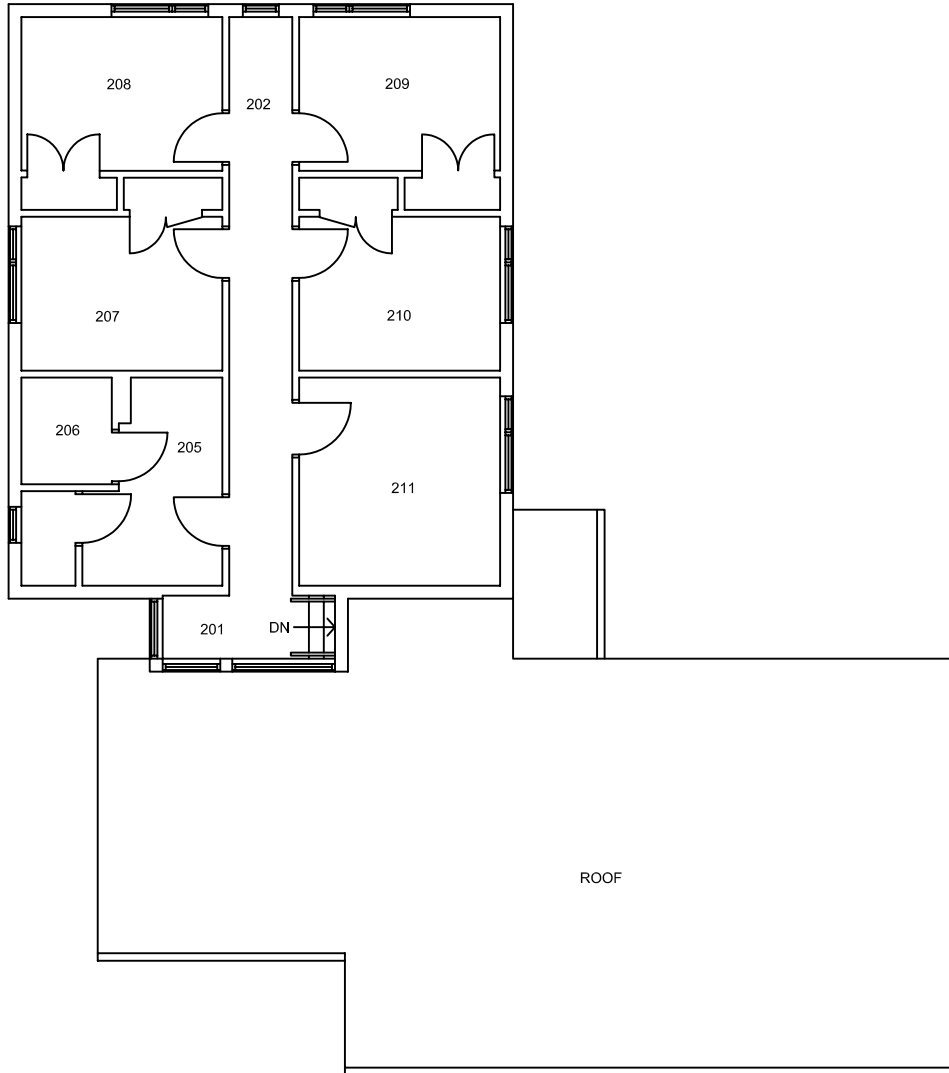
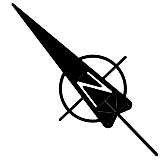
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 17	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



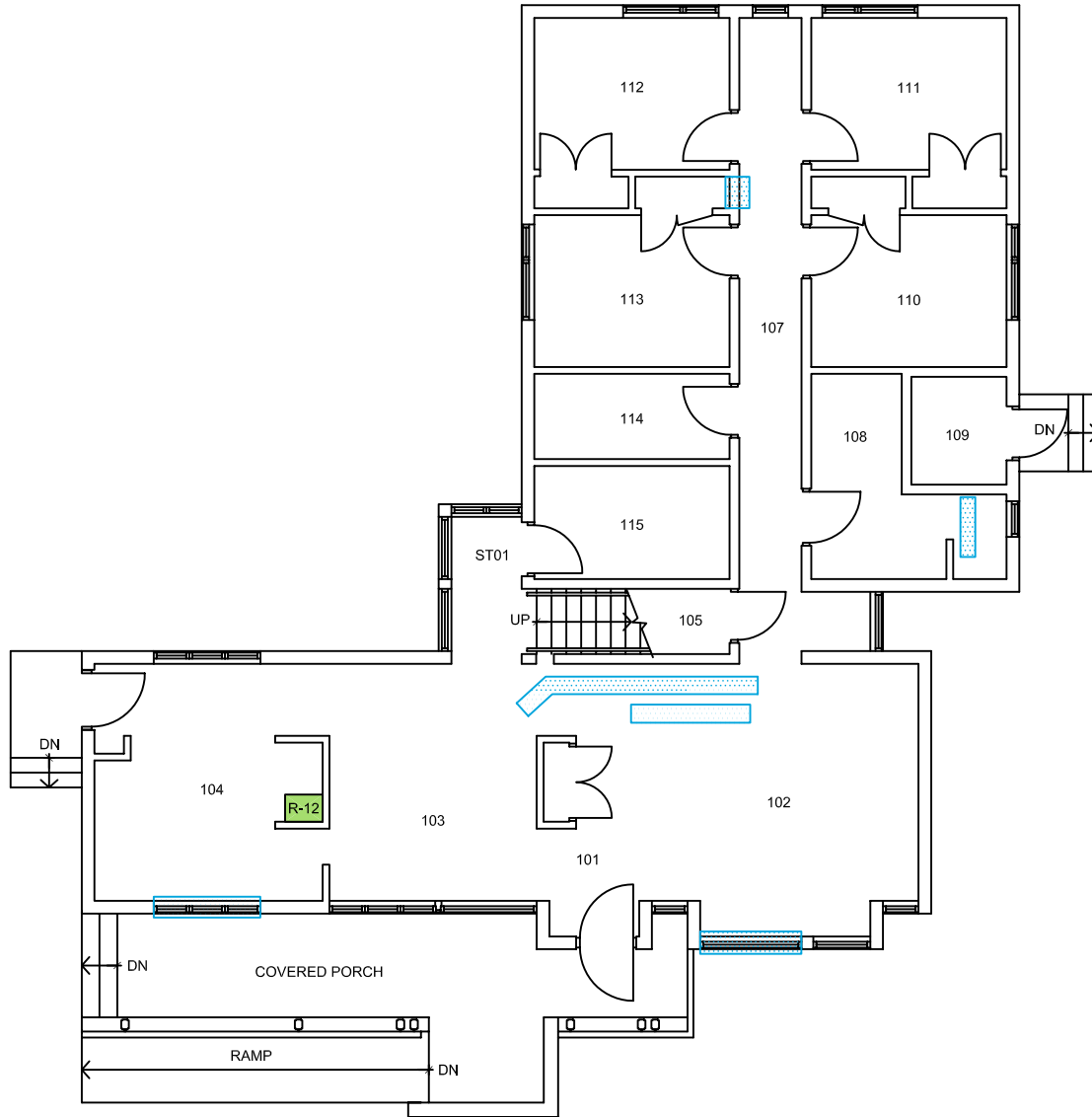
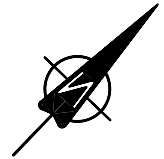


GVE07 - LIVING UNIT E7 - SECOND FLOOR

N. T. S.



NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	18	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE08 - LIVING UNIT E8 - GROUND FLOOR

LEGEND

-  EVIDENCE OF WATER DAMAGE
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
 GRAND VALLEY INSTITUTION FOR WOMEN
 1575 HOMER WATSON BOULEVARD
 KITCHENER, ONTARIO**

Job No.:
ONT36539.2

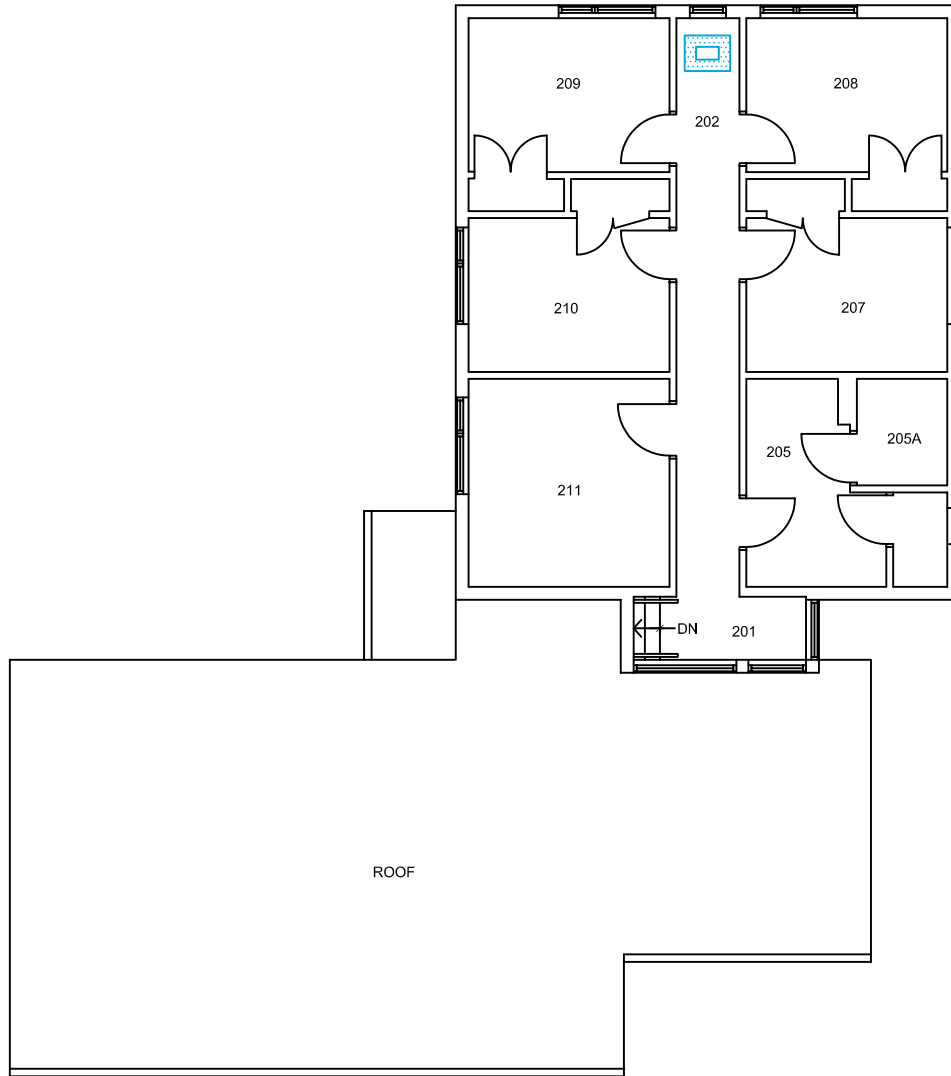
Dwg. No.:
19

Date:
04/03/08

Dwn. by:
LMV LMV

Appd.:
DS





GVE08 - LIVING UNIT E8 - SECOND FLOOR

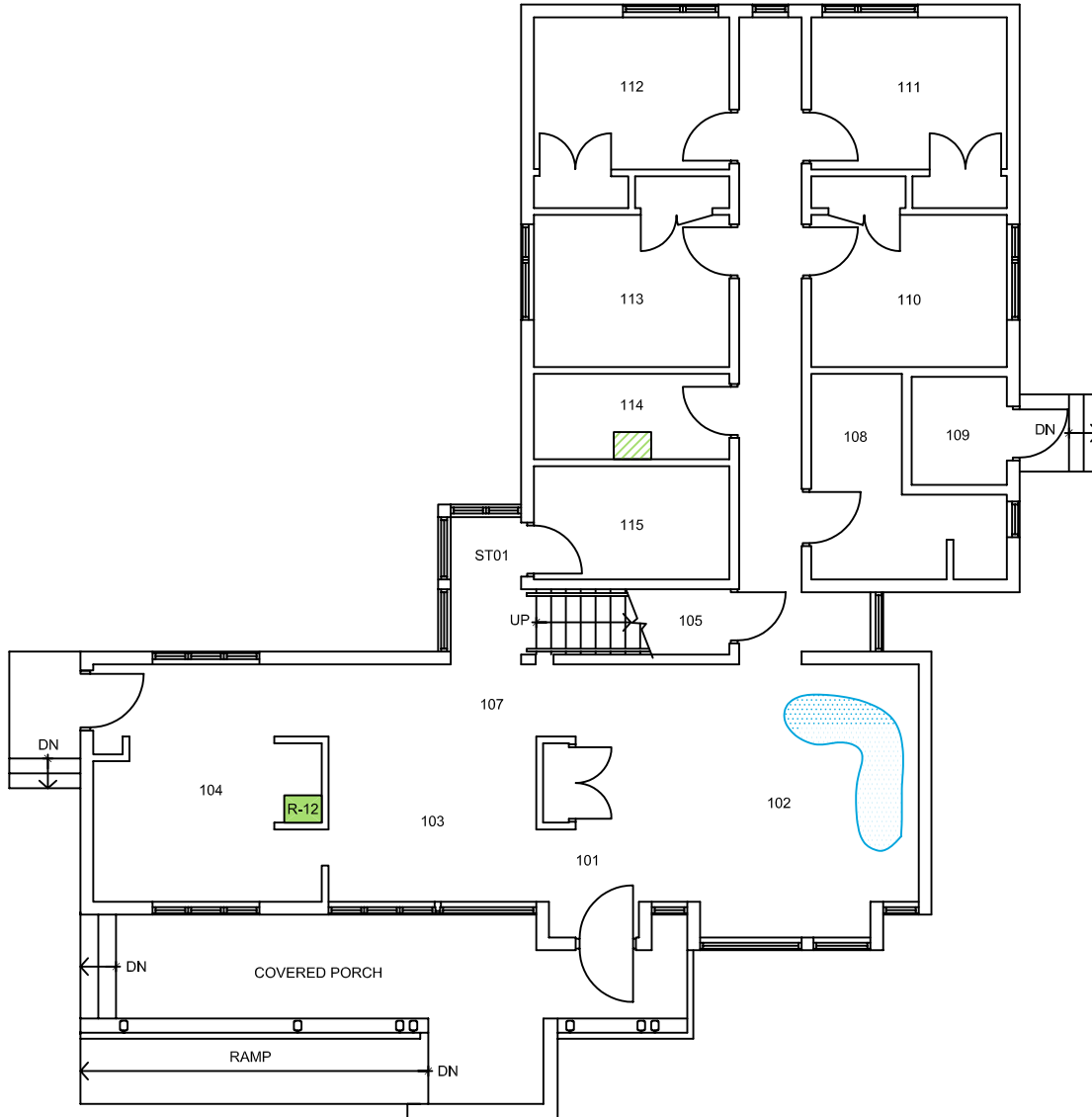
LEGEND

 EVIDENCE OF WATER DAMAGE

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	20	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE09 - LIVING UNIT E9 - GROUND FLOOR

LEGEND

- EVIDENCE OF WATER DAMAGE
- EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES
- EQUIPMENT PRESUMED TO CONTAIN OZONE DEPLETING SUBSTANCES

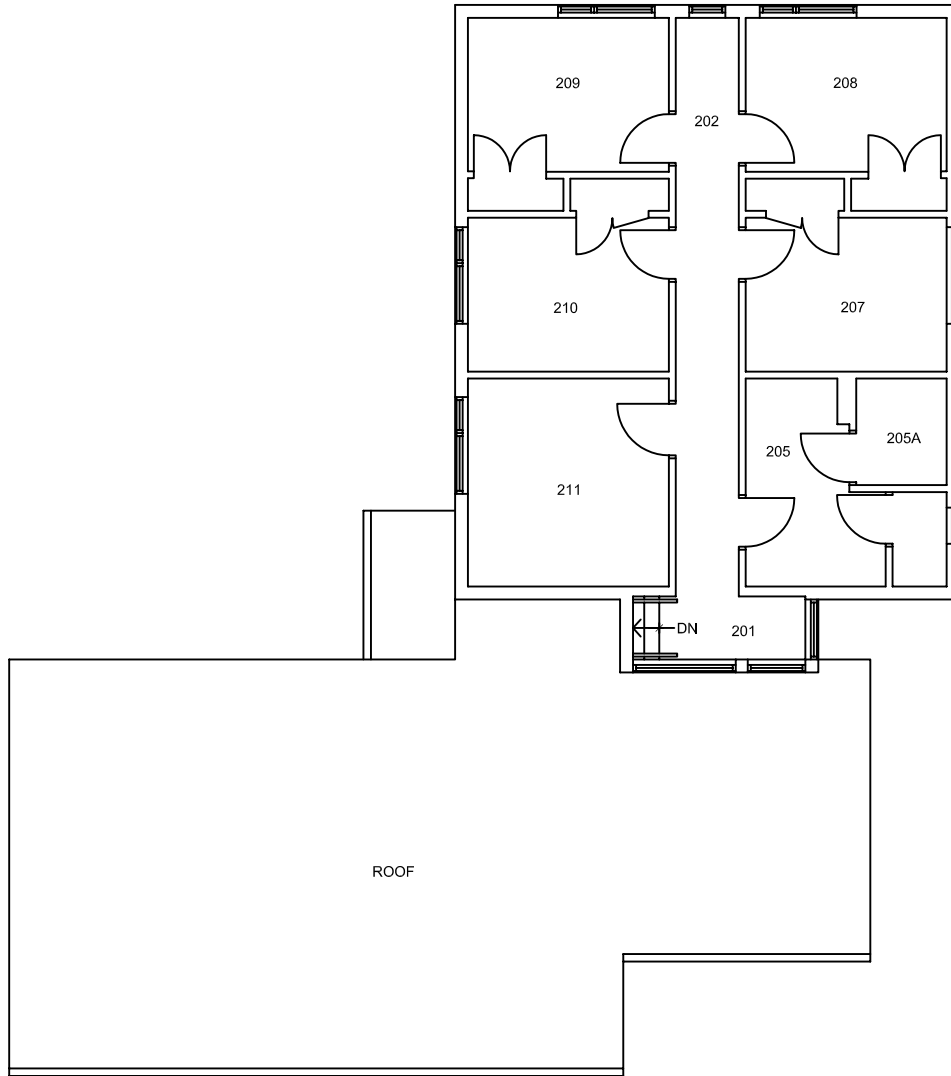
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 21	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



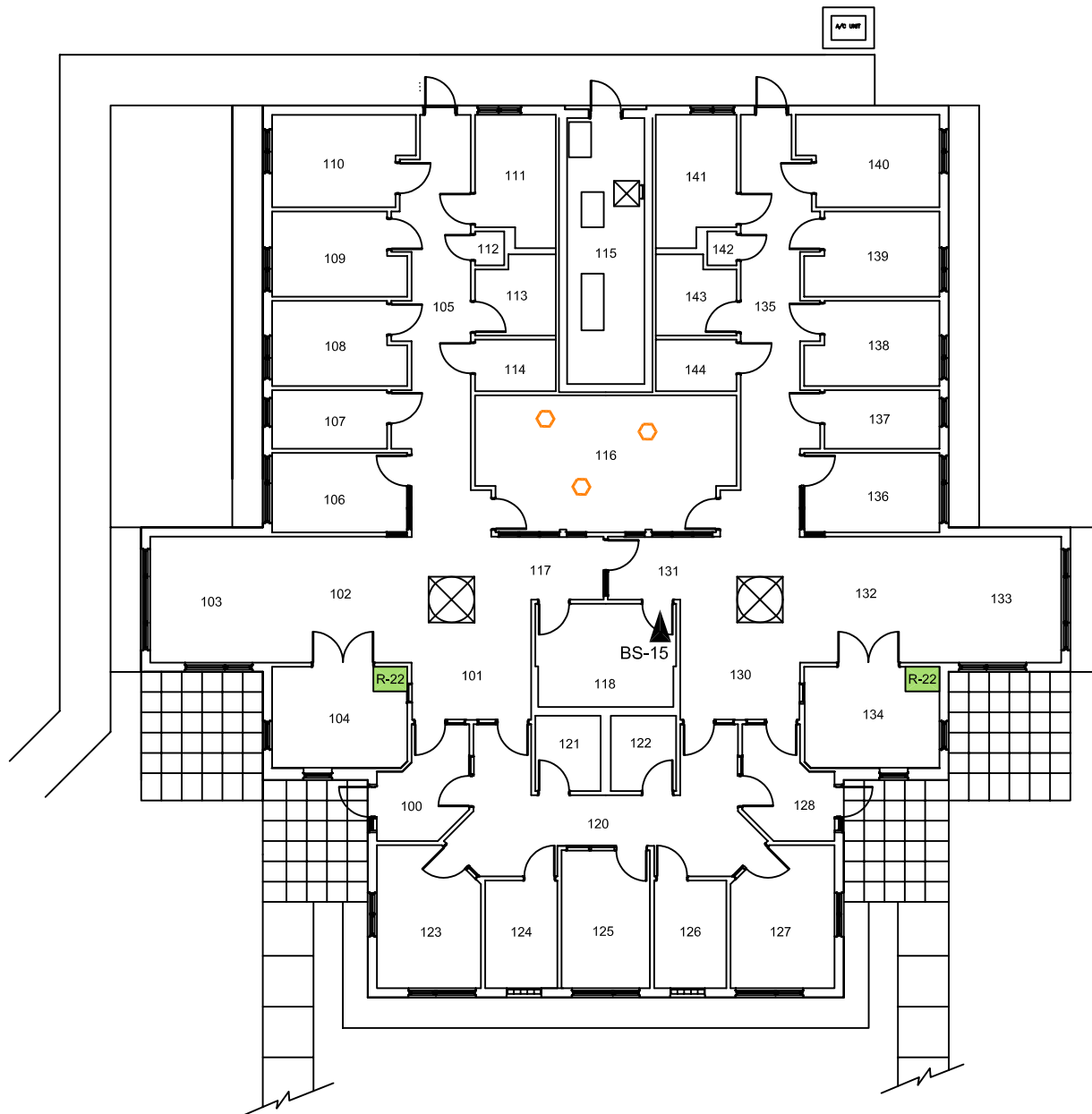
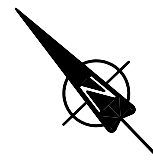


GVE09 - LIVING UNIT E9 - SECOND FLOOR




NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	22	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



LEGEND

-  BULK SAMPLE (ASBESTOS)
-  INSPECTED LAMP BALLAST (NON-PCB CONTAINING)
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES

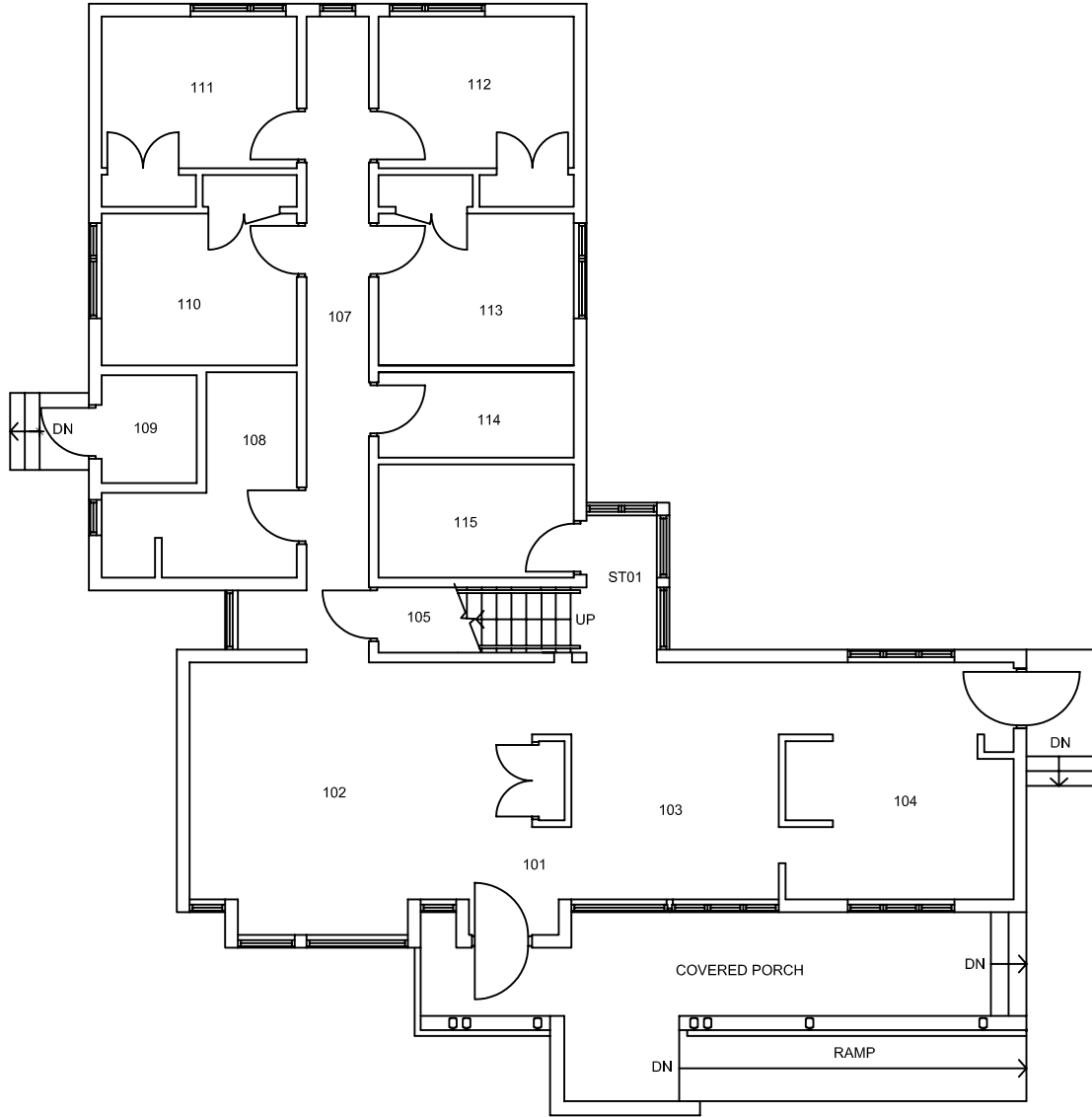
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
 GRAND VALLEY INSTITUTION FOR WOMEN
 1575 HOMER WATSON BOULEVARD
 KITCHENER, ONTARIO**

Job No.:	Dwg. No.:
ONT36539.2	23
Date:	Dwn. by:
04/03/08	LMV LMV
Appd.:	
DS	





GVE11 - LIVING UNIT E11- GROUND FLOOR

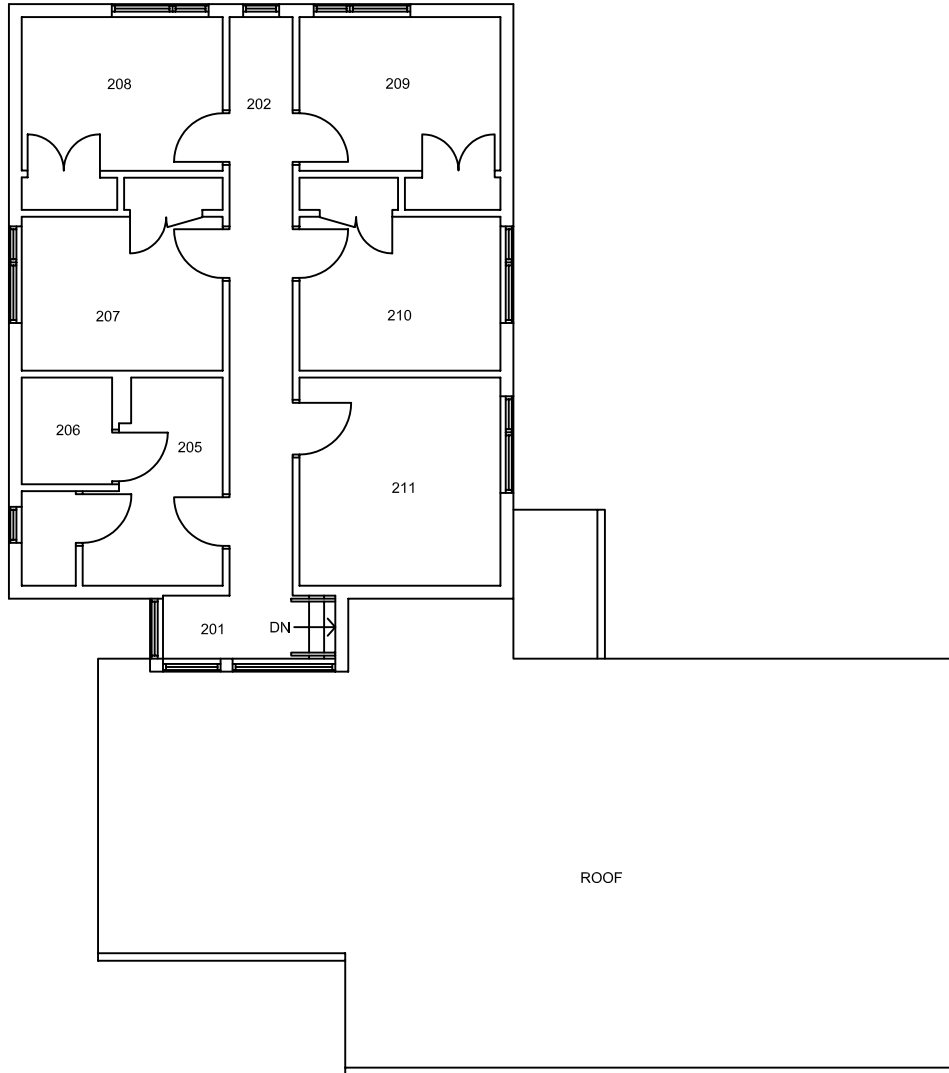
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 24	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



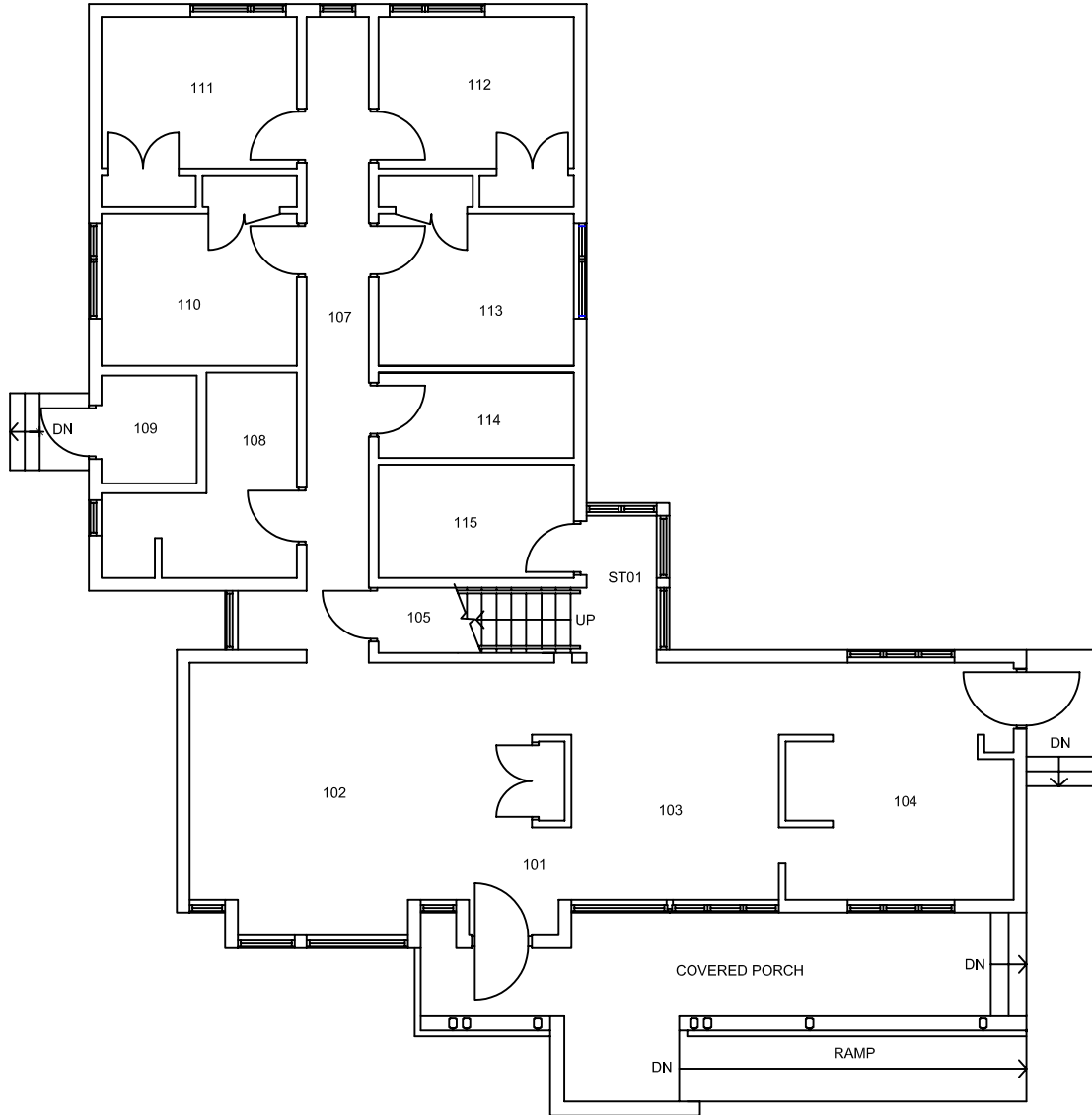
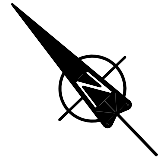


GVE11 - LIVING UNIT E11 - SECOND FLOOR

N. T. S.

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	25	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



GVE12 - LIVING UNIT E12- GROUND FLOOR

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.:
ONT36539.2

Dwg. No.:
26

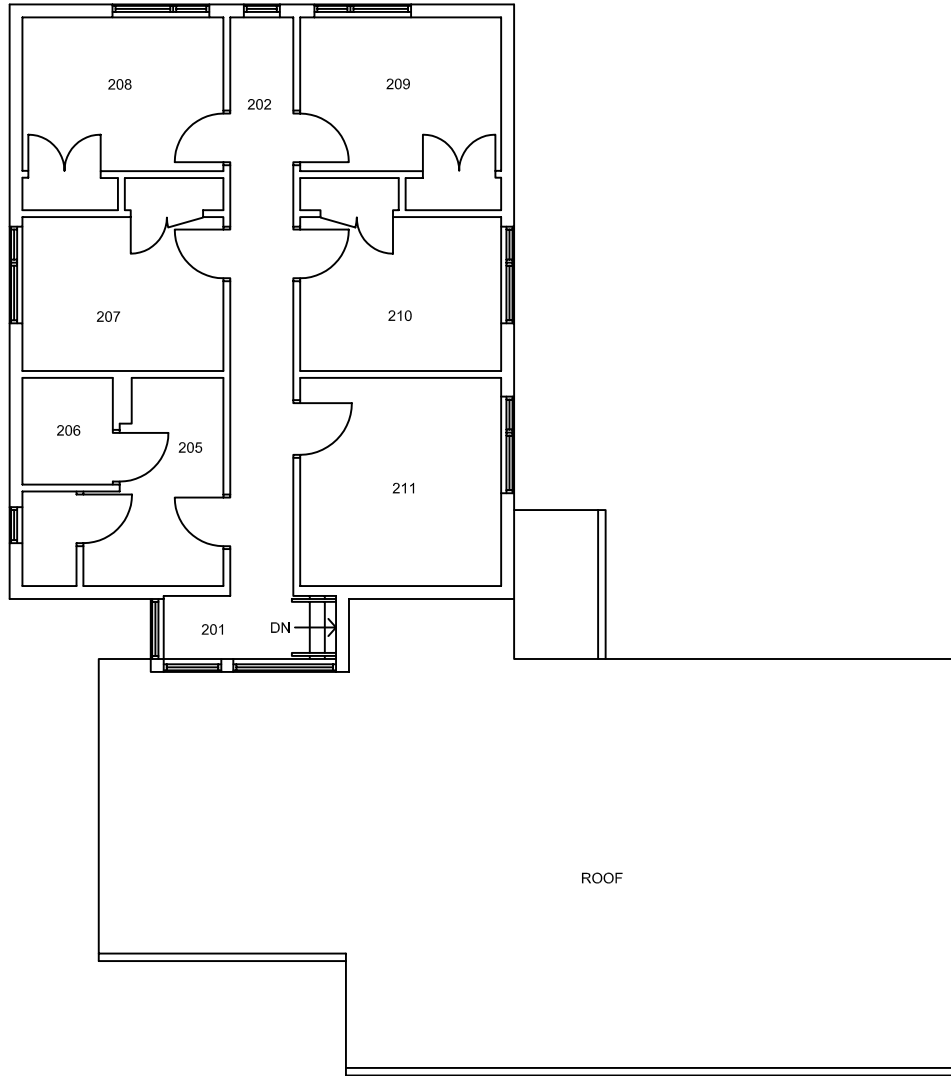
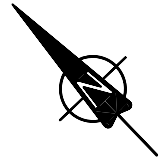
Date:
04/03/08

Dwn. by:
LMV LMV

Appd.:
DS



**Jacques
Whitford**



GVE12 - LIVING UNIT E12 - SECOND FLOOR

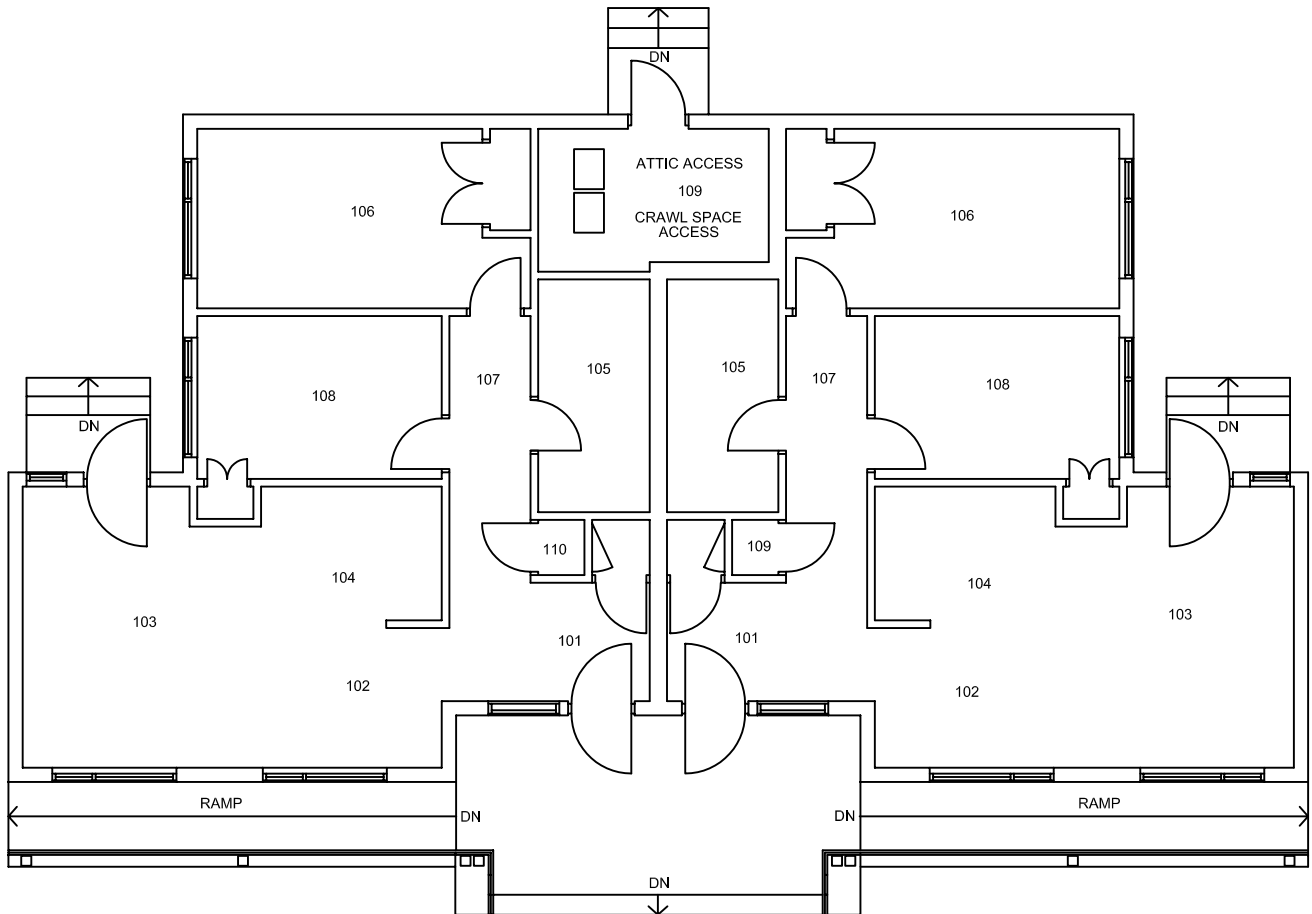
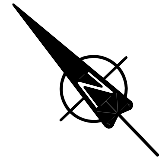
N. T. S.

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 27	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



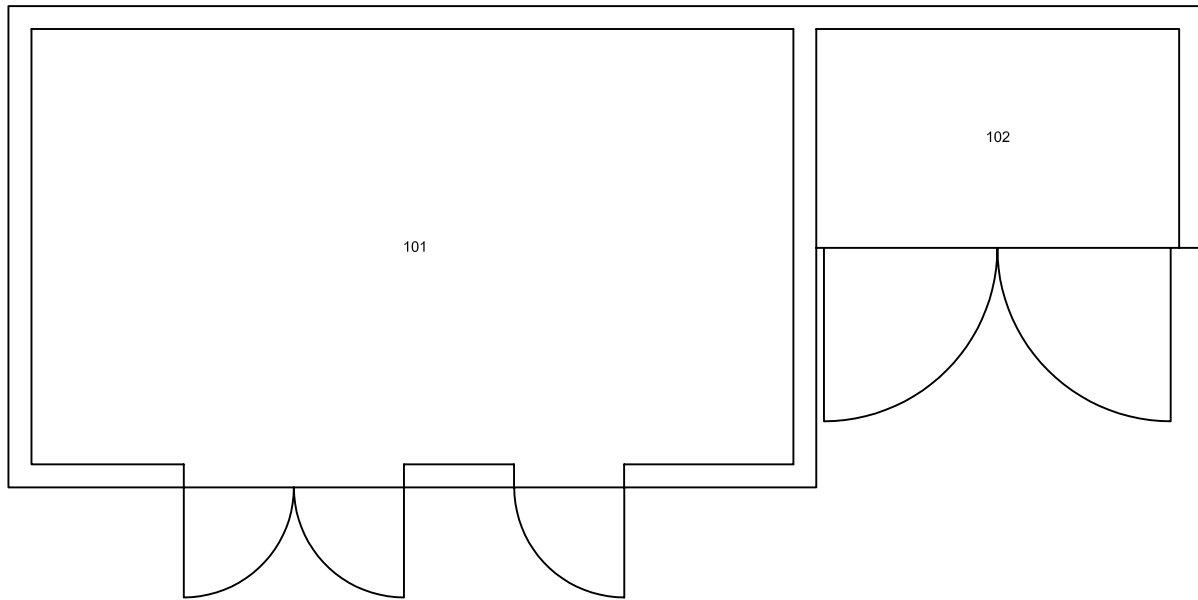
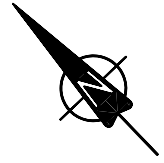


GVF01/GVF02 - PRIVATE FAMILY VISITING UNITS F1 AND F2

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	28	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	

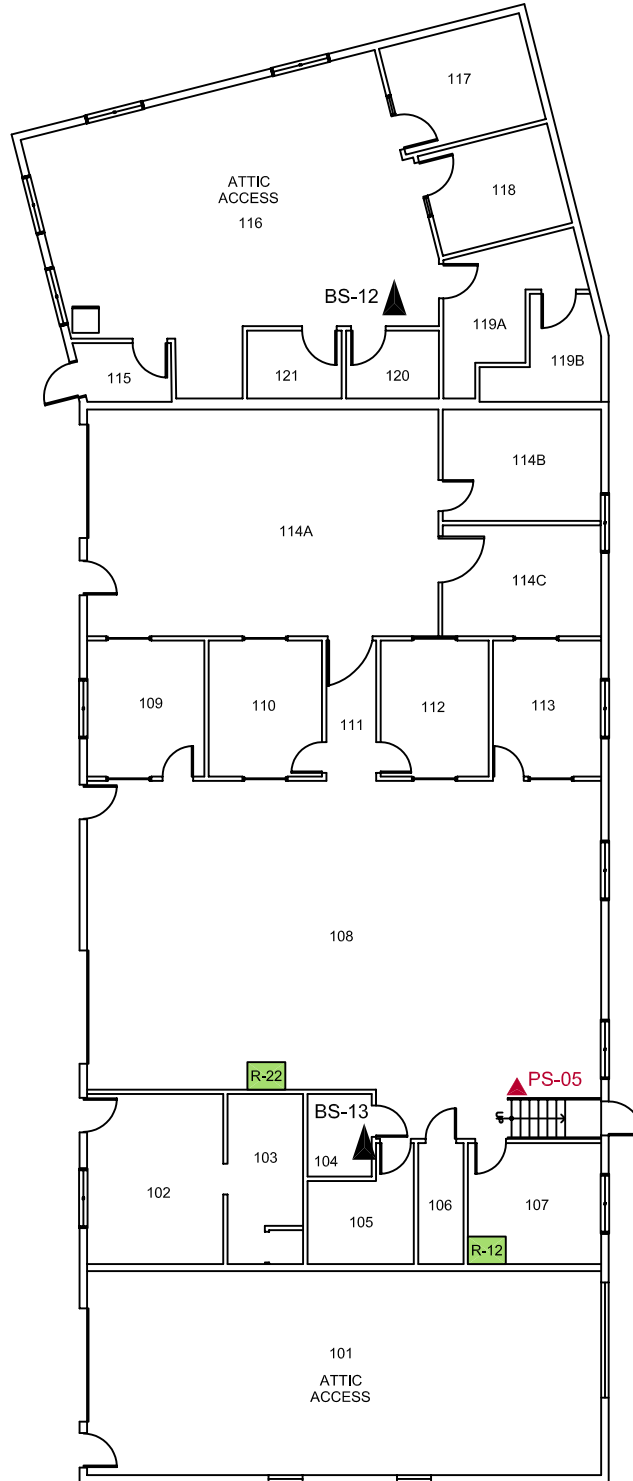


GVG01 - GARBAGE/COMPACT/RECYCLING ROOM




N. T. S.

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS GRAND VALLEY INSTITUTION FOR WOMEN 1575 HOMER WATSON BOULEVARD KITCHENER, ONTARIO	Job No.:	Dwg. No.:	 Jacques Whitford
	ONT36539.2	29	
Date:	Dwn. by:	Appd.:	
04/03/08	LMV LMV	DS	



LEGEND

-  BULK SAMPLE (ASBESTOS)
-  PAINT CHIP SAMPLE
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES

GVM01 - MAINTENANCE BUILDING - GROUND FLOOR

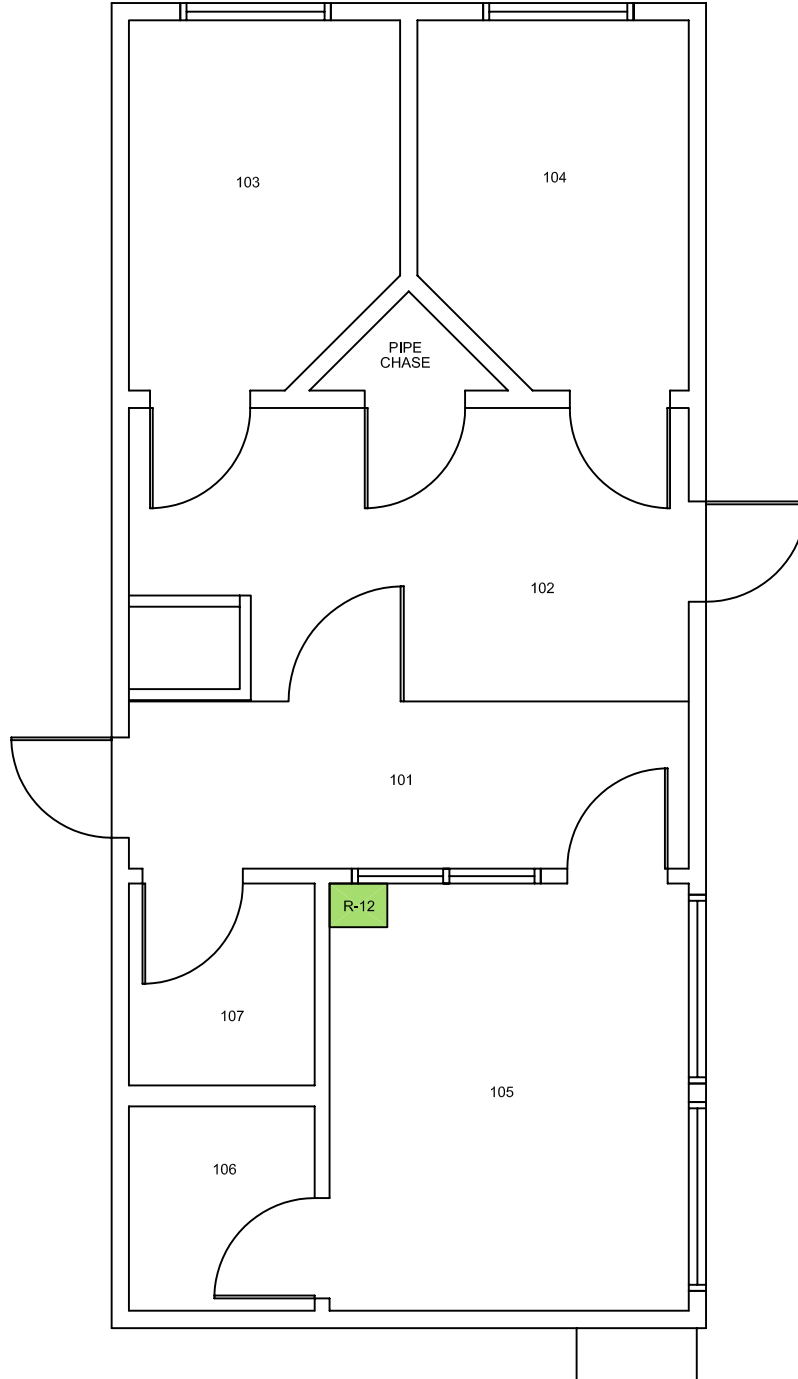
NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.




**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
 GRAND VALLEY INSTITUTION FOR WOMEN
 1575 HOMER WATSON BOULEVARD
 KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 30	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	





LEGEND

-  BULK SAMPLE (ASBESTOS)
-  PAINT CHIP SAMPLE
-  EQUIPMENT CONTAINING OZONE DEPLETING SUBSTANCES

GVST - SEGREGATION TRAILER

NOTE: LOCATIONS OF SITE FEATURES, SAMPLES AND EXTENT OF MATERIALS ARE APPROXIMATE AND MAY VARY FROM THAT SHOWN.

N. T. S.

**FLOOR PLAN SHOWING LOCATION OF DESIGNATED SUBSTANCES INCLUDING BULK ASBESTOS AND PAINT CHIP SAMPLING LOCATIONS
GRAND VALLEY INSTITUTION FOR WOMEN
1575 HOMER WATSON BOULEVARD
KITCHENER, ONTARIO**

Job No.: ONT36539.2		Dwg. No.: 31	
Date: 04/03/08	Dwn. by: LMV LMV	Appd.: DS	



APPENDIX 4

**SUMMARY OF RESULTS OF ANALYSIS OF
BULK SAMPLES FOR ASBESTOS CONTENT**



Summary of Results of Analysis for Asbestos Type and Content

Sample Number	Sampling Location	Description of Sampled Material	Asbestos Type and Content	Analysis
BS-01	A117 - Main Building (GVA01)	spray-on fireproofing	nd	PLM
BS-02	A106 - Main Building (GVA01)	1x1 grey with black VFT	nd	TEM
BS-03	B102 - Main Building (GVA01)	joint fill compound	nd	PLM
BS-04	B135 - Main Building (GVA01)	1x1 white with grey VFT	nd	TEM
BS-05	C122 - Main Building (GVA01)	2x4 white pinhole ceiling tile	nd	PLM
BS-06	C101 - Main Building (GVA01)	1x1 tan with grey VFT	nd	TEM
BS-07	C148 - Main Building (GVA01)	2x4 white pinhole ceiling tile	nd	PLM
BS-08	B135 - Main Buildng (GVA01)	1x1 grey with white VFT	nd	TEM
BS-09	C163 - Main Buildng (GVA01)	1x1 blue grey VFT	nd	TEM
BS-10	D125 - Main Buildng (GVA01)	linoleum	nd	PLM
BS-11	D103 - Main Buildng (GVA01)	multi-colour VFT	nd	TEM
BS-12	116 - Maintenance Building (GVM01)	2x4 white pinhole ceiling tile	nd	PLM
BS-13	104 - Maintenance Building (GVM01)	1x1 brown speckled VFT	nd	TEM
BS-14	109 - Dwelling E1 (GVE01)	linoleum	nd	TEM
BS-15	118 - Structured Living Environment Unit (GVE10)	2x2 white pinhole ceiling tile	nd	PLM

March 25, 2004

Page 4-1

PLM - Polarized Light Microscopy
 TEM - Transmission Electron Microscopy
 BS - Bulk Sample
 nd - None Detected

APPENDIX 5

SUMMARY OF FINDINGS FOR ASBESTOS-CONTAINING MATERIALS



Summary of Findings for Asbestos-Containing Materials

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Specific Location	ACM Location	ACM Type	Estimated Quantity	Sample Number	Original Sample?	Asbestos	Friable? Visible?	Access.	ACM Condition	Comments/Notes	
All	Entire Facility	Ground	Exterior	facility perimeter	roofs	all buildings	roofing materials	na	ns	No	na	No	Yes	C	good (SACM)	WHILE UNLIKELY THE POTENTIAL EXISTS FOR ACMS

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Accessibility Classificati

- A - Areas of the building within reach (from floor level) of all building users
- B - Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder
- C - Areas of the building above 2.4 m where use of a ladder is required to reach the asbestos
- D - Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc., where demolition of the ceiling, wall, or equipment, etc., is required to reach the asbestos

Visibility

- Yes - Suspect material is visible without opening hatches or lifting ceiling tiles
- No - Suspect material can only be viewed if access hatches are opened or ceiling tiles lifted.

* Based on a non-intrusive inspection of visible surfaces within the room s

- Notes:
- ACM - asbestos-containing material
 - SACM - suspect asbestos-containing material
 - Access. - accessibility
 - nq - not quantified
 - na - not applicable
 - ns - not sampled
 - REF - reference sample
 - x - estimated number of units
 - F - friable
 - NF - non friable
 - PFM - potentially friable material
 - S - Sample (original sample collected)
 - V - Visually identical sample

APPENDIX 6

**SUMMARY OF RESULTS OF ANALYSIS
OF PAINT SAMPLES FOR LEAD CONTENT**



Summary of Results of Analysis of Paint Samples for Lead Content

Sample/Assay Number	Sampling Location	Description	Lead Content (ppm)	Type of Analysis
PS-01	GVA01, B139 wall	light grey	nd	laboratory
PS-02	GVA01, DB01stored paint	blue	nd	laboratory
PS-03	GVA01, DB01stored paint	yellow	nd	laboratory
PS-04	GVA01, DB01stored paint	white	20	laboratory
PS-05	GVM01, 108 floor	grey	nd	laboratory
PS-06	GVE02-2E, hall (202) wall	light green	nd	laboratory

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nd - none detected

ppm - parts per million

XS - XRF Assay

PS - paint Sample

XRF - lead content analysis completed using X-Ray Fluorescenc spectrum analyzser

LAB - lead content analysis completed by laboratory analysis

negative - lead content determined to be less than 5,000 ppm

positive - lead content determined to be greater than 5,000 ppm

APPENDIX 7

SUMMARY OF FINDINGS FOR LEAD-CONTAINING MATERIALS

Summary of Findings for Lead-Based Materials

Bldg. I.D.	Bldg. Name	Level	Area	Specific Location	Type of Material	Description	Sample #	Lead Content	Comments
All	Entire Facility	Ground	Exterior	roof	mechanical and ventilation	vent and pipe flashings	na	ns	lead may be present within pipe and vent flashings
All	Entire Facility	Ground	Interior	various	ceramic tile	glaze on ceramic tile	na	ns	lead may be present within glaze coating on ceramic tile
All	Entire Facility	Ground	Interior	various	electical wiring	solder on electical wiring	na	ns	lead may be present in the form of solder in wiring

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Notes:

ppm - parts per million
 sq. m. - square meter
 na - not applicable
 ns - not sampled

negative - lead content determined to be less than 5,000 ppm by XRF assay.

positive - lead content determined to be less than 5,000 ppm by XRF assay.

* Airborne lead dust or fumes should not exceed the Ministry of Labour Time Weighted Average Exposure Value (TWAEV) of 0.05 milligrams per cubic metre (mg/m3) during the removal of paints and products containing any concentration of lead.

APPENDIX 8

SUMMARY OF FINDINGS FOR MERCURY-CONTAINING EQUIPMENT



Eco-Logo® Paper Papier Eco-Logo®



Summary of Findings for Mercury-Containing Equipment

Bldg. I.D.	Bldg. Name	Level	Room	Type of Equipment	Description	Equipment Model #	Equipment Serial #	Estimated Quantity	Comments
All	Entire Facility	Ground	Exterior	high intensity discharge bulbs	exterior lighting	na	na	300	mercury may be present within HID bulbs
All	Entire Facility	Ground	Interior	fluorescent bulbs	emergency lighting & exit signs	na	na	50	mercury vapour may be present within light bulbs
All	Entire Facility	Ground	Interior	fluorescent light tubes	interior lighting	na	na	1000	mercury vapour may be present within light tubes

Notes:

na - not available
nr - not recorded

APPENDIX 9

**SUMMARY OF FINDINGS FOR EQUIPMENT CONTAINING
POLYCHLORINATED BYPHENYLS (PCB)**



Summary of Findings for Equipment Containing Polychlorinated Byphenyls (PCB)

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Manufacturer	Nameplate Information	# of Units Inspected	Comments
GVA01	Main Building	Ground	A104	Office	light ballast	Flotronic Technology	no PCBs	2	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVA01	Main Building	Ground	C167	Food Distribution	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVA01	Main Building	Second	C201	Office	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVA01	Main Building	Second	C201	Classroom	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVA01	Main Building	Second	C208	Classroom	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVA01	Main Building	Second	C209	Classroom	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVE10	Structured Living Environment	Ground	116	Office	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVM01	Maintenance Building	Ground	116	Lunch Room	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE
GVM01	Maintenance Building	Ground	116	Lunch Room	light ballast	Flotronic Technology	no PCBs	1	NO PCB-CONTAINING EQUIPMENT IDENTIFIED AT THE SUBJECT SITE

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Notes:

Identification of PCB content in lamp ballasts is based on the Environment Canada document (Report EPS 2/CC/2) entitled "Identification of Lamp Ballasts Containing PCBs", August 1991.

APPENDIX 10

**SUMMARY OF FINDINGS FOR EQUIPMENT CONTAINING OZONE-
DEPLETING SUBSTANCES (ODS)**

Summary of Findings for Equipment Containing Ozone-Depleting Substances (ODS)

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Nameplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
All	Entire Facility	Ground	Exterior	facility perimeter	air conditioning unit	BS1009	1-97-B-8589-08	Comfort Aire	R22	30 oz.	refrigerant should be removed prior to decommissioning
All	Entire Facility	Ground	Exterior	facility perimeter	air conditioning unit	538CAX009	4196Y00585	BDP Company	R22	1.4 lbs	refrigerant should be removed prior to decommissioning
All	Entire Facility	Ground	Exterior	facility perimeter	air conditioning unit	538ANX018000B	0899X0399J	BDP Company	R22	3.6 lbs	refrigerant should be removed prior to decommissioning
All	Entire Facility	Ground	Exterior	facility perimeter	air conditioning unit	PUY-250TM-C	34W00086	Mitsubishi Electric Corp, manufactured Feb. 2001	R22	11.5 kg	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Ground	A104	Office	refrigerator	YRF1635W-51	DR376508V	McClary	R134a	unknown	device does not contain ODS
GVA01	Main Building	Ground	A117	Stores	refrigerator	MRT18DNGWO	BA82401407	White Westinghouse	R134a	5.0 oz	device does not contain ODS
GVA01	Main Building	Ground	B102	Entrance	air conditioner	unknown	unknown	nameplate missing	unknown	unknown	air conditioner is considered ODS suspect - confirm contents
GVA01	Main Building	Ground	B115	Visiting Facilities	pop machine	RVCC660-9	1526CL-00394	Coke	R134a	5.25 oz	device does not contain ODS
GVA01	Main Building	Ground	B115	Visiting Facilities	pop machine	RVMCE282-6 PE2745	0315117BE	Coke	R12	unknown	refrigerant should be removed
GVA01	Main Building	Ground	B135	Copy Room	refrigerator	TAC45NVYAB	MT13452	Camco - 07198	R134a	na	device does not contain ODS

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Namplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVA01	Main Building	Ground	C104	Treatment Room	refrigerator	TAC4SNTW	SR127284	date and manufacturer not recorded	R134a	2.6 oz	device does not contain ODS
GVA01	Main Building	Ground	C124	Medical Room	refrigerator	YRF1635W S1	DR376513V	McClary	R134a	6.0 g	device does not contain ODS
GVA01	Main Building	Ground	C141A	Hall	refrigerator	DMR1706WE	04522483	Danby - 1995-11	R12	5.8 oz.	refrigerant should be removed
GVA01	Main Building	Ground	C141A	Hall	freezer	unknown	unknown	nameplate missing	unknown	unknown	freezer is considered ODS suspect - confirm contents
GVA01	Main Building	Ground	C141A	Hall	refrigerator	DMR1706WE	0422486	Danby - 1995-11	R12	5.8 oz.	refrigerant should be removed
GVA01	Main Building	Ground	C162	Food Storage	freezer	RSW40SF	C99-0512	General Refrigerator	R404a	24 oz	device does not contain ODS
GVA01	Main Building	Ground	C162	Food Storage	freezer	RSW40SF	899-0249	General Refrigerator	R404a	24 oz	device does not contain ODS
GVA01	Main Building	Ground	C167	Food Distribution	freezer	MFC20M4FWO	WB70202874	Frigidaire	R134a	11.5 oz	device does not contain ODS
GVA01	Main Building	Ground	C167	Food Distribution	freezer	MFC25M4FWO	WB71604820	Frigidaire manufactured April 1997	R134a	13 oz	device does not contain ODS
GVA01	Main Building	Ground	D128	Kitchen	refrigerator	T-23	1-3044097	True Manufacturing Company	R134a	12 oz	device does not contain ODS
GVA01	Main Building	Ground	D128	Kitchen	refrigerator	T-23	1-3044162	True Manufacturing Company	R134a	12 oz	device does not contain ODS
GVA01	Main Building	Ground	D128	Kitchen	freezer	SKF27	SACH19095B	Silver King	R404a	7.5 oz	device does not contain ODS

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Namplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVA01	Main Building	Ground	D128	Kitchen	freezer	SKF27	SACH19096B	Silver King	R404a	7.5 oz	device does not contain ODS
GVA01	Main Building	Ground	D161	Common Area	refrigerator	BR18V1E	112308644AC	Amanda	R134a	4.25 oz	device does not contain ODS
GVA01	Main Building	Ground	D181	Office	refrigerator	DCR432W	0102030100368	Danby	R134a	1.59 oz	device does not contain ODS
GVA01	Main Building	Ground	D211	Common Area	refrigerator	BR18V1E	11230633AC	Amanda	R134a	4.25 oz	device does not contain ODS
GVA01	Main Building	Ground	D212	Common Area	refrigerator	BR18V1E	11230660AC	Amanda	R134a	4.25 oz	device does not contain ODS
GVA01	Main Building	Penthou	P01A	Mechanical Room	air conditioner	unknown	unknown	nameplate missing	unknown	unknown	refrigerator is considered ODS suspect - confirm contents
GVA01	Main Building	Penthou	P01Exterior	Penthouse Roof	roof mounted HVAC unit	HS29-036-9Y	5802H06242	Lennox	R22	5 lbs	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Penthou	P01Exterior	Penthouse Roof	roof mounted HVAC unit	HS29-048-9Y	5802J06855	Lennox	R22	5 lbs 3 oz	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C201	Classroom	air conditioner	PKFY-P32VGM-A	12J00487	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C202	Classroom	air conditioner	PKFY-P32GM-A	unknown	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C206	Classroom	air conditioner	PKFY-P32VGM-A	12G00325	Mitsubishi Electric Corp. manufactured 2001	R22	not listed	refrigerant should be removed prior to decommissioning

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Nameplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVA01	Main Building	Second	C206	Classroom	air conditioner	PKFY-P32VGM-A	12G00320	Mitsubishi Electric Corp. manufactured 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C207	Classroom	air conditioner	PKFY-P32VGM-A	12G00319	Mitsubish Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C208	Classroom	Air Conditioner	PKFY-P32VGM-A	12G00326	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C209	Classroom	air conditioner	PKFY-P32VGM-A	unknown	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C210	Classroom	air conditioner	PKFY-P32VGM-A	unknown	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVA01	Main Building	Second	C210	Classroom	air conditioner	PKFY-P32VGM-A	unknown	Mitsubishi Electric Corp. manufactured Feb. 2001	R22	not listed	refrigerant should be removed prior to decommissioning
GVE01	Dwelling Unit E1	Ground	104	Kitchen	refrigerator	R17NAD K2	13100173LK	W.C. Woods Co. Ltd. manufactured Nov. 2003	R134a	3.9 oz	device does not contain ODS
GVE01	Dwelling Unit E1	Ground	114	Storage Room	refrigerator	FFU09MFCWI	WB70913284	manufactured March 1997	R134a	6.5 oz	device does not contain ODS
GVE02	Dwelling Unit E2	Ground	104	Kitchen	refrigerator	R17WCB1 F2	06886159LF	manufactured Nov. 1999	R134a	3.9 oz	device does not contain ODS
GVE02	Dwelling Unit E2	Ground	114	Storage Room	refrigerator	unknown	unknown	nameplate missing	unknown	unknown	refrigerator is considered ODS suspect

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Nameplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVE03	Dwelling Unit E3	Ground	104	Kitchen	refrigerator	AFT40011	EC2325827	Admiral manufactured May 1993	information missing	4.5 oz	refrigerator is considered ODS suspect - confirm contents
GVE03	Dwelling Unit E3	Ground	114	Storage Room	refrigerator	V05WCA	068198050F	W.C. Woods Co. Ltd. manufactured Sept. 1999	R134a	4.2 oz	device does not contain ODS
GVE04	Dwelling Unit E4	Ground	104	Kitchen	refrigerator	DMR1706WE B1	04522485 LB	Danby manufactured Nov. 1995	R12	5.80 oz	refrigerant should be removed
GVE04	Dwelling Unit E4	Ground	114	Storage Room	refrigerator	unknown	unknown	nameplate missing	unknown	unknown	refrigerator is considered ODS suspect - confirm contents
GVE05	Dwelling Unit E5	Ground	104	Kitchen	refrigerator	R17NAD K3	09562108DK	W.C. Woods Co. Ltd. manufactured April 2003	R134a	3.9 oz	device does not contain ODS
GVE05	Dwelling Unit E5	Ground	114	Storage Room	refrigerator	MFU09M2BW4	WB73814701	Frigidaire manufactured Sept. 1997	R134a	6.5 oz	device does not contain ODS
GVE06	Dwelling Unit E6	Ground	104	Kitchen	refrigerator	R17WCB1	06576333 EF	W.C. Woods Co. Ltd. manufactured May 1995	R134a	3.9 oz	device does not contain ODS
GVE06	Dwelling Unit E6	Ground	114	Storage Room	refrigerator	MFU09M2BW3	WB70413709	Frigidaire manufactured Jan. 1997	R134a	6.5 oz	device does not contain ODS
GVE07	Dwelling Unit E7	Ground	104	Kitchen	refrigerator	DMR1706WE	04522475LB	Danby manufactured Nov. 1995	R12	5.8 oz	refrigerant should be removed

Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Namplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVE07	Dwelling Unit E7	Ground	114	Storage Room	refrigerator	unknown	unknown	Frigidaire missing nameplate	unknown	unknown	refrigerator is considered ODS suspect - confirm contents
GVE08	Dwelling Unit E8	Ground	104	Kitchen	refrigerator	DMR1706WE	04522481 LB	Danby manufactured Nov. 1995	R12	5.8 oz	refrigerant should be removed
GVE08	Dwelling Unit E8	Ground	114	Storage room	refrigerator	MFU09M2BW3	WB60504149	Frigidaire manufactured Feb. 1998	R134a	6.5 oz	device does not contain ODS
GVE09	Dwelling Unit E9	Ground	104	Kitchen	refrigerator	DMR1706WE	04522510 LB	Danby manufactured Nov. 1995	R12	5.8 oz	refrigerant should be removed
GVE09	Dwelling Unit E9	Ground	114	Storage Room	refrigerator	unknown	unknown	Frigidaire missing nameplate	unknown	unknown	refrigerator is considered ODS suspect - confirm contents
GVE10	Structured Living Environment	Ground	104	Kitchen	refrigerator	TTP042D300AD	R353RKF2F	AC-XE 1200 manufactured August 2000	R22	8 lbs 11 oz	refrigerant should be removed prior to decommissioning
GVE10	Structured Living Environment	Ground	114	Shower room	refrigerator	V05NAA	08261579 HK	W.C. Woods Co. Ltd. manufactured August 2001	R134a	3.4 oz	device does not contain ODS
GVE10	Structured Living Environment	Ground	116	Office	refrigerator	GR151R	010KR00459	LG	R134a	3.35 oz	device does not contain ODS
GVE10	Structured Living Environment	Ground	134	Kitchen	refrigerator	TTP042D300AD	R353RKF7H	AC-XE 1200 manufactured August 2000	R22	8 lbs 11 oz	refrigerant should be removed prior to decommissioning
GVE10	Structured Living Environment	Ground	143	Laundry Room	refrigerator	V05NAA	08617699 CJ	W.C. Woods Co. Ltd. manufactured March 2002	R134a	3.4 oz	device does not contain ODS

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Namplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVE11	Dwelling Unit E11	Ground	104	Kitchen	refrigerator	R17NAB	07733890MG	W.C. Woods Co. Ltd. manufactured Dec. 2000	R134a	3.9 oz	device does not contain ODS
GVE11	Dwelling Unit E11	Ground	114	Storage Room	refrigerator	V12NAA G3	01474516 MG	W.C. Woods Co. Ltd. manufactured Dec. 2000	R134a	4.1 oz	device does not contain ODS
GVE12	Dwelling Unit E12	Ground	104	Kitchen	refrigerator	R17NAB H2	07733881MG	W.C. Woods Co. Ltd. manufactured Dec. 2000	R134a	3.9 oz	device does not contain ODS
GVE12	Dwelling Unit E12	Ground	114	Storage Room	refrigerator	MFU09M2GWO	WB82802412	Frigidaire manufactured July 1998	R134a	7.0 oz	device does not contain ODS
GVFO10 2	Private Family Visiting Units	Ground	F1-104	Kitchen	refrigerator	YRF1635W S1	unknown	McClary	R134a	6.0 g	device does not contain ODS
GVFO10 2	Private Family Visiting Units	Ground	F2-104	Kitchen	refrigerator	YRF1635W S1	DR376507V	McClary	R134a	6.0 g	device does not contain ODS
GVM01	Maintenance Building	Ground	107	Kitchen	refrigerator	DMR1706WE	04522511	manufactured Nov. 1995	R12	5.8 oz	refrigerant should be removed
GVM01	Maintenance Building	Ground	108	Works Room	refrigerator	V12NAA	0147439MG	W.C. Woods Co. Ltd.	R134a	4.1 oz	device does not contain ODS
GVM01	Maintenance Building	Ground	108	Works Room	air conditioner	FA2526A	JFBS19381	date and manufacturer not recorded	R22	34 oz	refrigerant should be removed prior to decommissioning
GVM01	Maintenance Building	Ground	116	Lunch Room	refrigerator	FRT18G4AWA	BA33406542	Frigidaire manufactured August 2003	R134a	4.5 oz	device does not contain ODS

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Notes:

na - not available
nr - not recorded

Bldg . I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Equipment Model #	Equipment Serial #	Namplate Information	Refrigerant Type	Estimated ODS Quantity	Comments
GVST1	Segregation Trailer	Ground	102	Common Area	refrigerator	R05W CB	06796274JF	W.C. Wood Co. Ltd. manufactured Sept. 1999	R134a	3.5 oz	device does not contain ODS
GVST1	Segregation Trailer	Ground	102	Common Area	refrigerator	VO5NAA	07068014AG	W.C. Wood Co. Ltd. manufactured Jan. 2000	R134a	4.2 oz	device does not contain ODS
GVST1	Segregation Trailer	Ground	105	Control Post	refrigerator	DCR41WE	C9301862	Danby	R12	3.5 oz	refrigerant should be removed

Notes:

na - not available
nr - not recorded

APPENDIX 11

**SUMMARY OF WATER DAMAGED AREAS THAT
MAY BE IMPACTED BY MOULD**



Summary of Water Damaged Areas That May be Impacted by Mould

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Mould Indicator	General Location	Impacted Materials*	Estimated Quantity	Comments/ Notes
GVE01	Dwelling Unit E1	Ground	102	Living Room	water damage and cracking	north east ceiling area above living room	drywall	5 m2	a mould intrusive investigation should be considered
GVE02	Dwelling Unit E2	Ground	108	Washroom	water damage	north east ceiling area above toilet	drywall	>1 m2	a mould intrusive investigation should be considered
GVE03	Dwelling Unit E3	Ground	102	Living Room	water damage	north east area of ceiling at stairs	drywall	3 m2	a mould intrusive investigation should be considered
GVE03	Dwelling Unit E3	Second Floor	202	Hall	water damage	around attic hatch at north end of hall	drywall	>1 m2	a mould intrusive investigation should be considered
GVE04	Dwelling Unit E4	Ground	102	Living Room	water damage	east wall and ceiling at entrance	drywall	2 m2	a mould intrusive investigation should be considered
GVE04	Dwelling Unit E4	Ground	104	Kitchen	caulking damaged	at window behind sink	drwall	>1 m2	a mould intrusive investigation should be considered
GVE04	Dwelling Unit E4	Ground	108	Washroom	dark staining	on caulking at northeast corner of bathtub	caulking	>1 m2	remediate area & rectify source of moisture
GVE04	Dwelling Unit E4	Second Floor	205	Washroom	dark staining	on caulking at north corner of bathtub	caulking	2 m2	remediate area & rectify source of moisture
GVE07	Dwelling Unit E7	Ground	102	Living Room	water staining	damage throughout room in patches	drywall	5 m2	a mould intrusive investigation should be considered
GVE07	Dwelling Unit E7	Ground	108	Washroom	dark stianing	on bathtub caulking	caulking	2 m2	remediate area & rectify source of moisture
GVE08	Dwelling Unit E8	Ground	102	Living Room	water damage	south ceiling area at stairs	drywall	2 m2	a mould intrusive investigation should be considered
GVE08	Dwelling Unit E8	Ground	102	Living Room	water damage	on north window ledges	wood	>1 m2	a mould intrusive investigation should be considered
GVE08	Dwelling Unit E8	Ground	104	Kitchen	weather stripping damaged	on window behind sink	drywall	>1 m2	a mould intrusive investigation should be considered

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Notes:
 nq - not quantified
 na - not applicable

* Based on a non-intrusive inspection of visible surfaces within the room space.

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Mould Indicator	General Location	Impacted Materials*	Estimated Quantity	Comments/ Notes
GVE08	Dwelling Unit E8	Ground	107	Hall	wall bulge	lower wall between 112 and 113	drywall	3 m2	a mould intrusive investigation should be considered
GVE08	Dwelling Unit E8	Ground	108	Washroom	water damage	on ceiling above toilet	drywall	2 m2	a mould intrusive investigation should be considered
GVE08	Dwelling Unit E8	Second Floor	202	Hall	water damage	on ceiling around attic access port	drywall	2 m2	a mould intrusive investigation should be considered
GVE09	Dwelling Unit E9	Ground	102	Living Room	water damage	on ceiling at west side of room	drywall	3 m2	a mould intrusive investigation should be considered

Notes:
 nq - not quantified
 na - not applicable

* Based on a non-intrusive inspection of visible surfaces within the room space.

APPENDIX 12

**INVENTORY OF HAZARDOUS PRODUCTS
AND WASTES STORED AT THE FACILITY**



Inventory of Hazardous Products and Wastes Stored at the Facility

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVA01	Main Building	Groun	A104	Office	dish detergent	Dustbank	detergent	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A104	Office	glass cleaner	Wood & Wyant Inc	cleaner	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A104	Office	unlabelled	unlabelled	na	office sink	unknown	plastic jug
GVA01	Main Building	Groun	A104	Office	powder cleaner	Dutch Chemicals Inc.	cleaner	office sink	800 g	plastic bottle
GVA01	Main Building	Groun	A104	Office	powder cleaner	Colgate-Palmolive Canada Inc.	cleaner	office sink	800 g	cardboard bottle
GVA01	Main Building	Groun	A104	Office	Unlabelled (in glass cleaner but doesn't appear to be)	unlabelled	na	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A104	Office	cleaning solution	Root Industries Inc.	cleaner	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A104	Office	deodorizing detergent	Wood & Wyant Inc.	detergent	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A104	Office	cleaner	Flexo	cleaner	office sink	1 L	plastic bottle
GVA01	Main Building	Groun	A110	Custodial Closet	cleaner	Parkside Professional Products	hand cleaner	shelf	4 L	plastic jug
GVA01	Main Building	Groun	A110	Custodial Closet	un labelled (in degreaser bottle)	unlabelled	na	shelf	1 L	plastic bottle
GVA01	Main Building	Groun	A110	Custodial Closet	cleaner	G.H. Wood & Wyant Inc	deodorizing detergent	shelf	1 L	plastic bottle
GVA01	Main Building	Groun	A110	Custodial Closet	cleaner	United Laboratories Inc	all purpose cleaner	shelf	1 L	plastic bottle
GVA01	Main Building	Groun	A110	Custodial Closet	cleaner	G.H. Wood & Wyant Inc	bathroom cleaner	shelf	2 L	plastic bottle
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #8	Wood Wyant Inc.	deodourizing detergent	shelf	36 L	box

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #3	Wood Wyant Inc.	bathroom cleaner	cart	16 L	bottle
GVA01	Main Building	Groun	A117	Stores	Insecticide	Chem Free	insecticide	shelf in lockup #1	700 mL	can
GVA01	Main Building	Groun	A117	Stores	Hand Sanitizer	State Industries	hand sanitizer	on shelf	236 mL	can
GVA01	Main Building	Groun	A117	Stores	Insecticide	Airguard Control	insecticide	shelf in lockup #1	3.4 kg	can
GVA01	Main Building	Groun	A117	Stores	Penetrating Oil	Home Hardware	penetrating oil	shelf in lockup #1	342 g	can
GVA01	Main Building	Groun	A117	Stores	Rust Coat	Home Hardware	rust coat	shelf in lockup #1	400 g	can
GVA01	Main Building	Groun	A117	Stores	Oven Cleaner	Stafar Industries	oven cleaner	shelf in lockup #1	400 g	can
GVA01	Main Building	Groun	A117	Stores	Insecticide	Terand Industries Inc.	insecticide	shelf in lockup #1	5.2 kg	can
GVA01	Main Building	Groun	A117	Stores	Oven Cleaner	ATCO International	oven cleaner	on shelf	372 fl. oz.	can
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	cart	16 L	bottle
GVA01	Main Building	Groun	A117	Stores	Degreaser Cleaner	United Laboratories	degreaser cleaner	cart	15 L	bottle
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #8	Wood Wyant Inc.	deodourizing detergent	cart	20 L	jug
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #8	Wood Wyant Inc.	deodourizing detergent	cart	13 L	bottle
GVA01	Main Building	Groun	A117	Stores	Carpet Cleaner	Chem Shop	carpet cleaner	floor	20 L	pail
GVA01	Main Building	Groun	A117	Stores	Laundry Detergent	Parkside Professional Products	laundry detergent	floor	100 L	pail
GVA01	Main Building	Groun	A117	Stores	Hand Cleaner	Parkside Professional Products	hand cleaner	floor	140 L	pail
GVA01	Main Building	Groun	A117	Stores	Floor Cleaner	Flexo Products Ltd.	floor cleaner	floor	20 L	pail
GVA01	Main Building	Groun	A117	Stores	Floor Finish	Flexo Products Ltd.	floor finish	floor	80 L	pail
GVA01	Main Building	Groun	A117	Stores	Gum Dissolver	Chem Shop	gum dissolver	on shelf	470 g	can

March 25, 2004

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Notes:

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVA01	Main Building	Groun	A117	Stores	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	shelf	36 L	box
GVA01	Main Building	Groun	A117	Stores	Carpet Cleaner	Stafar Industries	carpet cleaner	shelf in lockup #1	400 g	can
GVA01	Main Building	Groun	A117	Stores	Laundry Detergent	Parkside Professional Products	detergent	shelf	15 kg	box
GVA01	Main Building	Groun	A117	Stores	Powder Cleaner	Dutch Chemicals Inc.	cleaner	shelf	228 kg	box
GVA01	Main Building	Groun	A117	Stores	Oven and Grill Cleaner	Parkside Professional Products	oven and grill cleaner	on shelf	24 L	can
GVA01	Main Building	Groun	A117	Stores	Drain Cleaner	ATCO International	drain cleaner	on shelf	256 fl. oz.	can
GVA01	Main Building	Groun	A117	Stores	Floor Stripper	Flexo Products Ltd.	floor stripper	floor	100 L	pail
GVA01	Main Building	Groun	A117	Stores	Insecticide	(Wilson) Nu-Gro IP Inc.	insecticide	shelf in lockup #1	3.6 kg	can
GVA01	Main Building	Groun	B154	Washroom	cleaning powder	Dutch Chemicals Inc.	cleaner	washroom	1000 g	plastic bottle
GVA01	Main Building	Groun	B154	Washroom	deodourizing cleaner	GH Wood & Wyant Inc.	cleaner	washroom	4 L	plastic jug
GVA01	Main Building	Groun	B154	Washroom	glass cleaner	GH Wood & Wyant Inc.	cleaner	washroom	600 mL	plastic bottle
GVA01	Main Building	Groun	B154	Washroom	bathroom cleaner	GH Wood & Wyant Inc.	cleaner	washroom	1.2 L	plastic bottle
GVA01	Main Building	Groun	B154	Washroom	liquid deodorant	GH Wood & Wyant Inc.	deodourant	washroom	300 mL	plastic bottle
GVA01	Main Building	Groun	B154	Washroom	detergent disinfectant	GH Wood & Wyant Inc.	detergent	washroom	600 mL	plastic bottle
GVA01	Main Building	Groun	B154	Washroom	hand cleaner	Parkside Professional Products	cleaner	washroom	4 L	plastic jug
GVA01	Main Building	Groun	C126	Laundry Room	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	on counter	2 X 1 L	plastic bottle
GVA01	Main Building	Groun	C126	Laundry Room	Pro-Fil #3	Wood Wyant Inc.	bathroom cleaner	on counter	2 X 1 L	plastic bottle
GVA01	Main Building	Groun	C126	Laundry Room	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter	6 X 1 L	plastic bottle

March 25, 2004

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Notes:

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVA01	Main Building	Groun	C126	Laundry Room	Javex bleach	Colgate Palmolive Canada Inc.	cleaner	on counter	5 X 3.6 L	plastic jug
GVA01	Main Building	Groun	C144	Custodial Closet	Floor finish	Flexo Products Ltd.	floor wax	on shelf	1 X 4 L	plastic jug
GVA01	Main Building	Groun	C144	Custodial Closet	deodorizing detergent	Wood Wyant Inc.	cleaner	on shelf	1 L	plastic bottle
GVA01	Main Building	Groun	C215	Custodial Closet	Pro-Fil #8	Wood Wyant Inc	deodorizing detergent	on shelf	3 L	plastic bottle
GVA01	Main Building	Groun	C215	Custodial Closet	Pro-Fil #1	Wood Wyant Inc	glass cleaner	on shelf	2 L	plastic bottle
GVA01	Main Building	Pentho	P01A	Boiler Room CSW 311		Drew Canada	water treatment for boilers	onb floor by boiler	55 lbs	plastic pail
GVE01	Dwelling Unit E1	Groun	104	Kitchen	dish soap	Dustbane	dish soap	in cabinet under sink	2 x 1 L	plastic bottles
GVE01	Dwelling Unit E1	Groun	108	Washroom	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter by sink	1 L	plastic bottle
GVE01	Dwelling Unit E1	Second	205	Washroom	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter by sink	1 L	plastic bottle
GVE02	Dwelling Unit E2	Groun	104	Kitchen	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	in cabinet under sink	1 L	plastic bottle
GVE02	Dwelling Unit E2	Groun	104	Kitchen	dish soap	unknown	dish soap	in cabinet under sink	2 X 1L	plastic bottle
GVE02	Dwelling Unit E2	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	400 g	plastic can
GVE03	Dwelling Unit E3	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	2 X 1L	plastic bottle
GVE03	Dwelling Unit E3	Groun	104	Kitchen	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	in cabinet under sink	1 L	plastic bottle
GVE04	Dwelling Unit E4	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVE04	Dwelling Unit E4	Groun	104	Kitchen	liquid soap	Wood Wyant Inc.	cleaner	in cabinet under sink	1 L	plastic bottle
GVE04	Dwelling Unit E4	Groun	104	Kitchen	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	in cabinet under sink	1 L	plastic bottle

March 25, 2004

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Notes:

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVE04	Dwelling Unit E4	Groun	108	Washroom	powder cleaner	Dutch Chemicals Inc.	cleaner	on counter by sink	400 g	plastic bottle
GVE04	Dwelling Unit E4	Groun	108	Washroom	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter by sink	3 X 1 L	plastic bottle
GVE05	Dwelling Unit E5	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	2 X 400 g	plastic bottle
GVE05	Dwelling Unit E5	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVE05	Dwelling Unit E5	Groun	104	Kitchen	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	in cabinet under sink	1 L	plastic bottle
GVE05	Dwelling Unit E5	Groun	104	Kitchen	dish soap	Wood Wyant Inc.	dish soap	on counter by sink	1 L	plastic bottle
GVE05	Dwelling Unit E5	Groun	115	Laundry Room	degreaser cleaner	United Laboratories	cleaner	on counter	4 X 1L	plastic bottle
GVE05	Dwelling Unit E5	Groun	115	Laundry Room	powder cleaner	Dutch Chemicals Inc.	cleaner	on counter	3 X 500 g	plastic bottle
GVE05	Dwelling Unit E5	Groun	115	Laundry Room	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	on counter	2 X 1L	plastic bottle
GVE05	Dwelling Unit E5	Groun	115	Laundry Room	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter	4 X 1 L	plastic bottle
GVE06	Dwelling Unit E6	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	500 g	plastic bottle
GVE06	Dwelling Unit E6	Groun	104	Kitchen	dish soap	unknown	dish soap	on counter by sink	1 L	plastic bottle
GVE06	Dwelling Unit E6	Groun	115	Laundry Room	degreaser cleaner	United Laboratories	cleaner	on counter	1 L	plastic bottle
GVE07	Dwelling Unit E7	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVE07	Dwelling Unit E7	Groun	104	Kitchen	dish soap	unknown	dish soap	on counter by sink	1 L	plastic bottle
GVE07	Dwelling Unit E7	Groun	108	Washroom	degreaser cleaner	United Laboratories	cleaner	on counter by sink & in cabinet below sink	2 X 1L	plastic bottle
GVE07	Dwelling Unit E7	Groun	108	Washroom	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter by sink	1 L	plastic bottle
GVE08	Dwelling Unit E8	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	400 g	plastic bottle

March 25, 2004

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Notes:

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVE08	Dwelling Unit E8	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVE08	Dwelling Unit E8	Groun	104	Kitchen	degreaser cleaner	United Laboratories	cleaner	in cabinet under sink	1 L	plastic bottle
GVE08	Dwelling Unit E8	Groun	104	Kitchen	dish soap	Citra clean	dish soap	in cabinet under sink	0.946 L	plastic bottle
GVE09	Dwelling Unit E9	Groun	104	Kitchen	dish soap	unknown	dish soap	on counter by sink	1 L	plastic bottle
GVE09	Dwelling Unit E9	Groun	115	Laundry	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	on counter	4 L	plastic jug
GVE09	Dwelling Unit E9	Groun	115	Laundry	dish soap	unknown	dish soap	on counter	1 L	plastic bottle
GVE11	Dwelling Unit E11	Groun	104	Kitchen	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVE11	Dwelling Unit E11	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	500 g	plastic bottle
GVE11	Dwelling Unit E11	Groun	104	Kitchen	dish soap	unknown	dish soap	in cabinet under sink	1 L	plastic bottle
GVE11	Dwelling Unit E11	Groun	115	Laundry	Pro-Fil #8	Wood Wyant Inc.	deodorizing detergent	on counter	2 x 4 L	plastic jugs
GVE11	Dwelling Unit E11	Groun	115	Laundry	degreaser cleaner	Wood Wyant Inc.	cleaner	on counter	1 L	plastic bottle
GVE12	Dwelling Unit E12	Groun	104	Kitchen	dish soap	unknown	dish soap	in cabinet under sink	1 L	plastic bottle
GVE12	Dwelling Unit E12	Groun	104	Kitchen	degreaser cleaner	United Laboratories	cleaner	in cabinet under sink	2 X 1L	plastic bottle
GVE12	Dwelling Unit E12	Groun	104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	3 X 500 g	plastic bottle
GVE12	Dwelling Unit E12	Groun	115	Laundry Room	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter	3 X 1 L	plastic bottle
GVFO10 2	Private Family Visiting Units	Groun	F1-104	Kitchen	dish soap	unknown	dish soap	in cabinet under sink	1 L	plastic bottle

March 25, 2004

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Notes:

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVFO10 2	Private Family Visiting Units	Groun	F1-104	Kitchen	Pro-fill #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVFO10 2	Private Family Visiting Units	Groun	F2-104	Kitchen	dish soap	unknown	dish soap	in cabinet under sink	2 X 1 L	plastic bottle
GVFO10 2	Private Family Visiting Units	Groun	F2-104	Kitchen	Pro-Fill #1	Wood Wyant Inc.	glass cleaner	in cabinet under sink	1 L	plastic bottle
GVFO10 2	Private Family Visiting Units	Groun	F2-104	Kitchen	powder cleaner	Dutch Chemicals Inc.	cleaner	in cabinet under sink	2 X 500 g	plastic bottle
GVM01	Maintenance Building	Groun	101	Diesel Room	diesel	unknown	diesel engine fuel	north west corner of room (interior and exterior)	900 L day tank and 2200 L main tank	metal tank with secondary containment and double walled metal tank
GVM01	Maintenance Building	Groun	101	Diesel Room	base sealer	Chem-shop	sealer	on floor	20 L	plastic pail
GVM01	Maintenance Building	Groun	102	ERT Area	pepper spray	Defense Technology Federal Lab	pepper spray	in safe	46.0 oz	MK 46V
GVM01	Maintenance Building	Groun	102	ERT Area	pepper spray	Defense Technology Federal Lab	pepper spray	on shelf	4 X unknown	T 16
GVM01	Maintenance Building	Groun	102	ERT Area	pepper spray	Defense Technology Federal Lab	pepper spray	on shelf	1.47 oz	MK 3
GVM01	Maintenance Building	Groun	102	ERT Area	pepper spray	Defense Technology Federal Lab	pepper spray	on shelf	2 X unknown	MK 4
GVM01	Maintenance Building	Groun	108	Works Room	oil	Esso	lubricant (10W40)	in locker	2 X 4 L	plastic bottle
GVM01	Maintenance Building	Groun	114B	Armoury	paint	Tremco	paint	on bench	340 g	metal pail
GVM01	Maintenance Building	Groun	119A	Custodial Closet	degreaser cleaner	United Laboratories	cleaner	on shelf	1 L	plastic bottle

Bldg. I.D.	Bldg. Name	Level	Room	Room Usage	Type of Material	Product Manufacturer	Usage of Material	Location of Material	Total Volume	Type of Container
GVM01	Maintenance Building	Groun	119A	Custodial Closet	liquid soap	Blue Mist	soap	on shelf	2 X 4 L	plastic jugs
GVM01	Maintenance Building	Groun	119A	Custodial Closet	detergent	MSA Canada Inc.	cleaner	on shelf	2 X 1 L	plastic bottle
GVST1	Segregation Trailer	Groun	105	Control Post	powder cleaner	Dutch Chemicals Inc.	cleaner	on counter by sink	400 g	plastic bottle
GVST1	Segregation Trailer	Groun	105	Control Post	Pro-Fil #1	Wood Wyant Inc.	glass cleaner	on counter by sink	1 L	plastic bottle

APPENDIX 13

**LABORATORY ANALYTICAL REPORT – ASBESTOS:
POLARIZED LIGHT MICROSCOPY (PLM) AND TRANSMISSION
ELECTRON MICROSCOPY (TEM)**



EMSL Analytical, Inc.

107 Haddon Ave., Westmont, NJ 08108

Phone: (856) 858-4800 Fax: (856) 858-4950 Email: ssl@emsl.com

EMSLAttn: David Stevens
Jacques Whitford Environment Limited
1200 Denison Street
Markham, Ontario, CN L3R 8G6

Fax: (905) 479-9326 Phone: (416) 495-8614

Project: ONT 36539.002

Customer ID: JWC151
Customer PO: ONT 36539.002
Received: 03/10/04 12:02 PMEMSL Order: 040404150
EMSL Proj:
Analysis Date: 3/15/04**Polarized Light Microscopy (PLM) Performed by NIOSH Method 9002, Issue 2**

Sample	Location	Appearance	Treatment	Non-Asbestos		Asbestos
				% Fibrous	% Non-Fibrous	% Type
BS-01 040404150-0001		Gray Fibrous Heterogeneous	Teased	90% Glass	10% Non-fibrous (other)	None Detected
BS-03 040404150-0002		White Non-Fibrous Heterogeneous	Teased		100% Non-fibrous (other)	None Detected
BS-05 040404150-0003		Gray/White Fibrous Heterogeneous	Teased	30% Cellulose 10% Glass	60% Non-fibrous (other)	None Detected
BS-07 040404150-0004		Brown/Gray/White Fibrous Heterogeneous	Teased	30% Cellulose 10% Glass	60% Non-fibrous (other)	None Detected
BS-10 040404150-0005		Tan Fibrous Heterogeneous	Teased	20% Cellulose	80% Non-fibrous (other)	None Detected
BS-12 040404150-0006		Gray/White Fibrous Heterogeneous	Teased	30% Cellulose 10% Glass	60% Non-fibrous (other)	None Detected
BS-15 040404150-0007		Gray/White Fibrous Heterogeneous	Teased	30% Cellulose 10% Glass	60% Non-fibrous (other)	None Detected

Analyst(s)

Will DiBella (7)

Stephen Siegel, CIH
or other approved signatory

EMSL Analytical, Inc.

107 Haddon Ave., Westmont, NJ 08108

Phone: (856) 858-4800 Fax: (856) 858-4960 Email: ssiegel@EMSL.com



EMSL

Attn: David Stevens
Jacques Whitford Environment Limited
1200 Denison Street
Markham, Ontario, CN L3R 8G6

Fax: (905) 479-9326 Phone: (416) 495-8614

Project: ONT 36539.002

Customer ID: JWC151
Customer PO: ONT 36539.002
Received: 03/10/04 12:02 PM

EMSL Order: 040404151
EMSL Proj:
Analysis Date: 3/15/2004

Asbestos Analysis of Bulk Materials via Transmission Electron Microscopy. Chatfield Method (rev 2)

SAMPLE ID	COLOR	MATRIX MATERIAL	NON-ASBESTOS FIBERS	RANGE	ASBESTOS TYPE	AVG
BS-02 040404151-0001	Gray	100.0%	ND		ND	
BS-04 040404151-0002	White	100.0%	ND		ND	
BS-06 040404151-0003	light gray	100.0%	ND		ND	
BS-08 040404151-0004	Gray	100.0%	ND		ND	
BS-09 040404151-0005	light gray	100.0%	ND		ND	
BS-11 040404151-0008	Brown	100.0%	ND		ND	
BS-13 040404151-0007	Brown	100.0%	ND		ND	
BS-14 040404151-0008	light gray	100.0%	ND		ND	

Analyst(s)

Debbie Little (8)

Stephen Siegel, CIH
or other approved signatory

The above report relates only to the items tested. This report may not be reproduced, except in full, without written approval by EMSL Analytical, Inc. The test results contained within this report meet the requirements of NELAP unless otherwise noted.

ACCREDITATIONS: AIHA #100194, NVLAP #101048-D and NY STATE ELAP #10872

TEM Chatfield-2

THIS IS THE LAST PAGE OF THE REPORT.

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APPENDIX 14

**LABORATORY ANALYTICAL REPORT – LEAD:
PAINT CHIP ANALYSIS**



Report of Analysis

Client : Jacques Whitford Environment Ltd.
 Contact: David Stevens

Report Date: March 15/2004
 Lab Ref # : G240994
 Lab Quote #: JWEL-03
 Client PO#: ONT36539.002
 Client Ref#: ONT36539.002

Analysis of Paint

Parameter	EQL	Units	PS-01	PS-01	PS-02	PS-03	PS-04
			2004/03/04	Replicate	2004/03/04	2004/03/04	2004/03/04
Lead	10	mg/kg	nd	nd	nd	nd	20

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
 nd parameter not detected ! = EQL higher than listed due to dilution () Adjusted EQL

Report of Analysis

Client : Jacques Whitford Environment Ltd.
 Contact: David Stevens

Report Date: March 15/2004
 Lab Ref # : G240994
 Lab Quote #: JWEL-03
 Client PO#: ONT36539.002
 Client Ref#: ONT36539.002

Analysis of Paint

Parameter	EQL	Units	PS-05	PS-06			
			2004/03/04	2004/03/04			
Lead	10	mg/kg	nd	nd			

EQL Estimated Quantitation Limit = lowest level of the parameter that can be quantified with confidence.
 nd parameter not detected ! = EQL higher than listed due to dilution () Adjusted EQL

APPENDIX 15

**EVALUATION CRITERIA FOR ASSESSING
ASBESTOS-CONTAINING MATERIALS**



Criteria for Assessing Asbestos Containing Materials

A description of the criteria used in evaluating the condition, accessibility and exposure risk of asbestos-containing materials is provided below. The criteria is generally based on the Public Works and Government Services Canada (PWGSC) document entitled "Deputy Ministers Directive 057 – Asbestos Management" (Last Revised 1999/07/16) and industry standards of practice.

Assessment of Condition

Spray Applied Fireproofing, Insulation and Textured Finishes

In evaluating the condition of ACM spray applied as fireproofing, thermal insulation or texture, decorative or acoustic finishes, the following criteria apply:

Good

Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the surveyor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.

Poor

Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of ACM spray.

In observation areas, where damage exists in isolated locations, both GOOD and POOR condition may be reported. The extent or percentage of each condition will be recorded on the surveyor reassessment form.

FAIR condition is not utilized or considered as a valid criterion in the evaluation of sprayed fireproofing, sprayed insulation, or texture coat finishes.

The evaluation of ACM spray applied as fireproofing, non-mechanical thermal insulation, or texture, decorative or acoustic finishes which are present above ceilings, may be limited by the number of observations made, and by building components such as ducts or full height walls that obstruct the above ceiling observations. Persons entering the ceiling area are advised to be watchful for ACM



DEBRIS prior to accessing or working above ceilings in areas of buildings with ACM, regardless of the reported condition.

Other ACM

In evaluating the condition of mechanical insulation (on boilers, breaching, ductwork, piping, tanks, equipment etc.) the following criteria are used:

Good

Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e., scuffs or stains), but the jacketing is not penetrated.

Fair

Minor penetration damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.

Poor

Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired. The evaluation of mechanical insulation may be limited by the number of observations made and building components such as ducts or full height walls that obstruct observations. In these circumstances, it is not possible to observe each foot of mechanical insulation from all angles.

Non-Friable and Potentially Friable Materials

Non-friable materials generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials, i.e., exterior asbestos cement products, may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material will be treated as a friable product.

Evaluation of Accessibility

The accessibility of building materials known or suspected of being ACM is rated according to the following criteria:

Designated Substances and Hazardous Materials Survey – Final Report
Grand Valley Institution for Women, 1575 Homer Watson Blvd., Kitchener, Ontario
Public Works and Government Services Canada

Project No. ONT36539.2
March 25, 2004
Appendix 15 – Page 2

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Éco-Loggi Paper Paper Eco-Loggi



Access (A)

Areas of the building within reach of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users may result in disturbance of ACM not normally within reach from floor level.

Access (B)

Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, i.e., tops of equipment, mezzanines.

Access (C) Exposed

Areas of the building above 8'0" where use of a ladder is required to reach the ACM. Only refers to ACM materials that are exposed to view, from the floor or ladder, without removing or opening other building components such as ceiling tiles, or service access doors or hatches. Does not include infrequently accessed service areas of the building.

Access (C) Concealed

Areas of the building which require the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces, etc. Observations are limited to the extent visible from the access points.

Access (D)

Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc. where demolition of the ceiling, wall or equipment, etc., is required to reach the ACM. Evaluation of the condition and extent of ACM is limited or impossible, depending on the surveyor's ability to visually examine the materials in Access D.

Evaluation of Exposure Risk

The exposure risk of building materials known or suspected of being ACM is rated according to the following criteria:

Rating "1"

Little or no perceived risk associated with material in its present condition

Rating "2"

Minor upgrades or repairs are required to reduce a potential exposure hazard

Rating "3"

A significant exposure hazard exists, with immediate remedial action required



APPENDIX 16

TERMS AND DEFINITIONS



Terms and Definitions

Abatement (lead)

A measure or set of measures designed to permanently eliminate lead-based paint hazards or lead-based paint. Abatement strategies include the removal of lead-based paint, enclosure, encapsulation, replacement of building components coated with lead-based paint, removal of lead-contaminated dust. All of these strategies require preparation; cleanup; waste disposal; postabatement clearance testing; recordkeeping; and, if applicable, monitoring.

Asbestos

Any of the following asbestiform silicate minerals: actinolite asbestos, anthophyllite asbestos, chrysotile, crocidolite, cummingtonite-grunerite asbestos (amosite), tremolite asbestos.

Asbestos Operations and Maintenance Program (O&M)

An active program that details procedures for the clean up asbestos fibres previously released, measures to prevent future releases by minimizing asbestos-containing material disturbance or damage, and the monitoring of the condition of asbestos-containing materials.

Friable

Capable of being crumbled, pulverized or reduced to powder by hand pressure.

HEPA Filter

A high efficiency particulate aerosol filter that is at least 99.97 per cent efficient in collecting a 0.3 micrometre aerosol.

Polarized Light Microscopy (PLM)

Polarized Light Microscopy is a technique accepted by the US Environmental Protection Agency as a screening method for detecting asbestos fibres in bulk material samples.

Presumed Asbestos Containing Materials (PACMs)

Materials that are known to have been manufactured contain asbestos. Testing of the material is required to determine if the material contains asbestos fibres.

Recommended Corrective Actions (RCAs)

Areas identified to consist of designated substances that require attention to repair or remove damaged materials.



RCA strategies for lead-based paint include the removal of lead-based paint, enclosure, encapsulation, replacement of building components coated with lead-based paint, removal of lead-contaminated dust. All of these strategies require preparation; cleanup; waste disposal; post-abatement clearance testing; record-keeping; and, if applicable, monitoring.

Short Term Exposure Limit (STEL)

The concentration to which it is believed that workers can be exposed continuously for a short period of time (15 minutes) without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily time weighted average exposure value is not exceed.

Time Weighted Average Exposure Value (TWAEV)

Defined as the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.

X-Ray Fluorescence Spectrum Analyzer (XRF)

A portable instrument that determines lead concentration of paint applications in milligrams per square centimeter (mg/cm²) using the principle of x-ray fluorescence.



APPENDIX 17

SELECTED SITE PHOTOGRAPHS





Photo 1: View of typical hazardous materials used for cleaning found throughout the subject facility.



Photo 2: View of water damage on living room ceiling of Dwelling Unit E1.



Photo 3: View of water damage on living room window ledge of dwelling Unit E8.



Photo 4:View of dark staining suspected of being mold in the bathroom (108) of Dwelling Unit E7.



**Public Works and Government Services Canada
Ontario Region**

**Grand Valley Institution Proposed Principal
Entrance Addition
1575 Homer Watson Boulevard
Kitchener, Ontario**

Geotechnical Investigation Report

Date: March 25, 2011

Ref. N°: 160-P038209-0101-GE-0001-00





**Public Works and Government Services Canada
Ontario Region**

**Grand Valley Institution Proposed Principal
Entrance Addition
1575 Homer Watson Boulevard
Kitchener, Ontario**

Geotechnical Investigation Report



Prepared by:



Karen Thrans, Dipl.-Ing.
Project Manager

Reviewed by:



Dave S. Naylor, P.Eng.
Senior Consulting Engineer



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Property and Confidentiality

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Test results mentioned herein are only valid for the sample(s) stated in this report.

LVM inc.'s subcontractors who may have accomplished work either on site or in laboratory are duly qualified as stated in our Quality Manual's procurement procedure. Should you require any further information, please contact your Project Manager.*

Client:

Public Works and Government Services Canada, Ontario Region
 4900 Yonge Street
 Toronto, Ontario M2N 6A6
 Attention: Mr. Rudy Pitton

REVISION AND PUBLICATION REGISTER		
Revision N°	Date	Modification And/Or Publication Details
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INTRODUCTION

LVM inc. has been retained to carry out a geotechnical investigation for the proposed principal entrance addition at the Grand Valley Institution located at 1575 Homer Watson Boulevard in Kitchener, Ontario at the location shown on Drawing 1, appended. This work was authorized on March 09, 2011, in Contract No. EQ734-113618/001/PWL.

The purpose of this investigation was to determine the subsurface soil and groundwater conditions at the site and, based on this information, prepare this geotechnical engineering report with recommendations regarding site preparation, foundation design, and concrete slab on grade design.

1 GENERAL INFORMATION

This project involves the construction of an approximately 675 m² addition to the principal entrance of the Grand Valley Institution. The site of the new principal entrance is located to the southeast of the existing main building and in the vicinity of the cul-de-sac north of Homer Watson Boulevard. It is understood that the new addition will be a two-storey slab on grade structure.

2 INVESTIGATION PROCEDURE

2.1 PREVIOUS WORK

In 1989, LVM inc. (England Naylor Engineering Ltd. prior to 1998) carried out a geotechnical investigation at the subject site:

- ▶ England Naylor Engineering Ltd. Geotechnical Investigation – Property Option, Homer Watson Boulevard and Manitou Drive, Kitchener, Ontario. (Project No. 89G034)

The fieldwork for this investigation included two boreholes near the subject site. The relevant information from the above noted report has been included in this report and the borehole logs are appended.

2.2 FIELD PROGRAM

The fieldwork for this investigation was carried out on March 21 and 22, 2011 and involved the drilling of six boreholes (Boreholes 101-11 to 106-11) to depths of 6.4 to 6.6 m at the locations shown on the appended Site Plan, Drawing 2. The boreholes were advanced with a CME-75 track-mounted drillrig equipped with continuous flight solid stem augers.

Local utility companies were contacted prior to the start of drilling activities in order to demarcate underground utilities near the boring locations.

Soil samples were recovered from the boreholes at regular 0.75 and 1.50 m depth intervals using a 50 mm outside diameter split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure. Pocket penetrometer tests were performed on samples of the cohesive soils to determine approximate shear strengths. The SPT N-values and shear strength test results are plotted on the appended borehole logs.

Groundwater observations and measurements were carried out in the open boreholes during and upon completion of drilling, and the observations are summarized on the appended borehole logs.



Upon completion of drilling, the boreholes were backfilled with bentonite in accordance with the Ontario Regulations 372/07 (formerly O.Reg. 903) under the province's Water Resources Act.

The fieldwork was observed by a member of our geotechnical engineering staff who documented the drilling and sampling procedures; recorded the SPT N-values and shear strengths; documented the soil stratigraphies; recorded the groundwater observations; and cared for the recovered soil samples.

The borehole locations and ground surface elevations were surveyed by LVM inc. The boreholes were located relative to existing site features and property lines, and the ground surface elevations are referred to the following temporary benchmarks (TBM) provided by Public Works and Government Services Canada (Site Servicing Plan, dated 2011-03-02):

TBM1: Top of finished floor at pedestrian entrance to GVLTS building, at the location shown on Drawing 2.

Elevation: 305.62 m (geodetic datum)

2.3 LABORATORY TESTING

The soil samples secured during this investigation were returned to our laboratory for visual examination as well as moisture content tests. The moisture content test results are plotted on the borehole logs.

The soil samples will be stored for a period of three months from the date of sampling. After this time, they will be discarded unless prior arrangements have been made for longer storage.

3 SUMMARIZED CONDITIONS

The site is located to the southeast of the main building and currently comprises a cul-de-sac and grassed area. Grades at the borehole locations range between Elevation 304.6 and 305.5 m.

The subsurface stratigraphy at the site generally comprises pavement structure and fill overlying native deposits of sand, silt, and silt till. Descriptions of the various soil deposits encountered are provided in the following subsections.

We refer to the appended borehole logs for soil descriptions and stratigraphies, results of moisture content testing, and groundwater observations.

3.1 PAVEMENT STRUCTURE

Boreholes 102-11, 105-11, and 106-11 were advanced through the existing pavement structure. The pavement structure comprises 110 to 140 mm of asphaltic concrete overlying 250 to 400 mm of Granular 'A' base course. No Granular 'B' subbase course was contacted in any of the boreholes.

3.2 FILL

Fill was contacted surficially in Boreholes 101-11, 103-11, and 104-11 and underlying the pavement structure in Boreholes 102-11, 105-11 and 106-11, and is 0.8 to 2.1 m thick. The upper 0.3 to 0.4 m of the surficially contacted fill comprises dark brown silt (topsoil) and was moist at the time of fieldwork. The underlying fill ranges in composition from silt with some clay to sand with some silt and fine gravel. Some silt and clay layers, as well as sand layers were contacted within the fill in Boreholes 103-11 and 106-11, respectively. The upper portions in Boreholes 102-11 and 106-11 were frozen at the time of fieldwork. Generally, the non-cohesive portions of the fill were damp to very moist and the cohesive portions were drier than to about the plastic limit at the time of sampling. SPT N-values in the non-cohesive fill range from 3 to 20 blows per 300 mm penetration of the split-spoon sampler, indicating a very loose to compact relative density. The cohesive portions of the fill have a firm consistency.

3.3 NATIVE DEPOSITS

Silt was encountered in Boreholes 104-11, 106-11, 21 and 22 underlying the fill or interlayered with the sand deposit. The silt contacted in Borehole 106-11 extends below the termination depth of the borehole. The deposit ranges in composition from sandy silt to clayey silt. The non-cohesive portions of the silt were wet at the time of fieldwork and the cohesive portions were drier than to about the plastic limit. An SPT N-value in the non-cohesive silt of 6 blows per 300 mm indicates a loose relative density. Shear strengths determined on samples of the cohesive silt ranged from 25 to greater than 225 kPa, indicating variable firm to hard consistencies. A hard consistency was contacted at a depth of 4.1 m (Elevation 300.5 m) in Borehole 106-11.

Silt till was contacted in Borehole 102-11 at a depth of 2.3 m (Elevation 302.7 m) and in Borehole 22 (ENE 89G034) at Elevation 299.2 m. The cohesive silt till contacted in Borehole 102-11 comprises clayey silt with trace sand and gravel and was drier than the plastic limit. The non-cohesive silt till deposit encountered in Borehole 22 ranged in composition from silt with trace to some sand to sandy silt. The cohesive silt till has a hard consistency based on shear strengths of greater than 225 kPa.

Sand was contacted in Boreholes 101-11 to 105-11, Borehole 21 and 22 underlying the fill, silt, or silt till deposits, and extends below the termination depths of these boreholes with the exception of Borehole 22.

The deposit comprises fine to coarse sand with trace silt and trace to no gravel and was variable damp to very moist. Some clayey silt layers were contacted within the sand in Borehole 104-11. Some saturated sandy silt layers were encountered within the sand deposit in Borehole 21. SPT N-values in the sand deposit range from 10 to greater than 50 blows per 300 mm penetration of the split spoon sampler, indicating compact to very dense relative densities. Loose conditions were encountered within the upper portion of the sand deposit in Borehole 104-11.

3.4 GROUNDWATER

Groundwater observations and measurements carried out in the open boreholes are provided on the appended borehole logs. No free groundwater was encountered in the current boreholes indicating that the stabilized groundwater table lies below the termination depths of the boreholes.

4 DISCUSSION AND RECOMMENDATIONS

The project involves the construction of the new principal entrance addition connecting to the existing main building of the Grand Valley Institution. It is anticipated that the finished floor of the addition will be close to existing grades, matching the existing finished floor elevation of the main building.

The soil conditions encountered at the site comprise pavement structure and fill overlying native deposits of sand, silt and glacial till. Loose sand and silt deposits were encountered near Borehole 104-11. The silt deposit encountered near Borehole 106-11 has a firm consistency to a depth of 3.5 m (Elevation 301.1 m). The following subsections provide recommendations on the foundation systems.

4.1 FOUNDATION DESIGN

The contacted fill and upper loose sand and loose/firm silt deposits are not considered suitable to support the footings of the proposed addition and there are two alternatives that should be considered: constructing the footings on approved structural fill or lowering the footings down into the competent native deposits encountered at depths between 1.5 and 2.3 m (Elevation 302.3 and 304.0 m).

The following table summarizes the depths to the competent native soil:

Table 1 Native Mineral Soil Depths and Elevations

BOREHOLE NUMBER	DEPTH TO COMPETENT NATIVE SOILS		ELEVATION OF NATIVE SOIL
		(M)	(M)
101-11		1.5	303.9
102-11		2.3	302.7
103-11		2.1	302.6
104-11		1.5	304.0
105-11		2.3	302.6
106-11		2.3	302.3

Footings founded on the engineered structural fill and native mineral soils may be designed for a factored geotechnical bearing resistance at Ultimate Limit States (ULS) of 250 kPa and a soil bearing resistance for 25 mm of settlement at Serviceability Limit States (SLS) of 150 kPa.

Structural fill should comprise clean granular material such as OPSS Granular 'B'. The engineered structural fill should be placed in maximum 300 mm thick lifts and compacted to 100% standard Proctor maximum dry density (SPMDD). The structural fill should extend at least 1.0 m beyond the footing edge of the proposed structures and outwards and downwards to the subgrade level at a slope of 1.0 horizontal to 1.0 vertical.

Compaction testing by experienced geotechnical personnel should be carried out to examine and approve structural fill materials, and to verify that the specified degree of compaction has been achieved.

Where the footings of the proposed addition abut the footings of the existing building, the footing levels should match in order to avoid uneven stress distribution and/or undermining.

Where it is necessary to construct footings at different elevations, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize risk of undermining the upper footing.

The footing areas must be inspected by a geotechnical engineer to confirm that the soil conditions encountered at the time of construction are suitable to support the design bearing resistances. Any loose or disturbed soils identified during the inspection should be removed from the footing areas and replaced with concrete.

All exterior footings and those exposed to freezing should be provided with 1.2 m of soil cover to provide protection from freezing. If construction extends into the winter months, all founding soil must be protected from freezing during construction.

Excavations for fill removal and foundation construction should be straightforward. All trench excavations should comply with the current regulations under the Ontario Occupational Health and Safety Act. Predominant soils at the site will be classified as Type 3 soils, and temporary side slopes must be sloped back at a 1 horizontal to 1 vertical from the base of the excavation.

Groundwater is not expected to be encountered in excavations for fill removal and construction of the foundations. Any minor groundwater seepage should be handled using conventional sump pumping and trenching techniques.

In general, the inorganic granular material excavated from the foundation trench areas will be suitable for reuse as foundation wall backfill and should be stockpiled separately. The backfill should be placed in 300 mm thick lifts and compacted to 95% SPMDD. The backfill should be brought up evenly on both sides of walls not designed to resist lateral earth pressure. Over-compaction must be avoided since this could cause excessive lateral earth pressure.

A Site Classification 'D' should be used for earthquake load and effects in accordance with Table 4.1.8.4.A of the Ontario Building Code (2006).

4.2 CONCRETE SLAB ON GRADE

The floor slabs for the proposed building addition may be constructed using conventional concrete slab-on-grade techniques following removal of the existing surficial topsoil (fill) layer, and inspection of the subgrade soils by a geotechnical engineer.

Any fill required to raise grades below the proposed structure should comprise clean granular material such as OPSS Granular 'B'. The floor slab fill should be compacted to 100% SPMDD.

A minimum 150 mm thick layer of Granular 'A' material compacted to 100% SPMDD should be provided directly beneath the slab for levelling and uniform support purposes.

No special under floor drains are required provided the exterior grades are lower than the floor slab and positively sloped away from the building.

A modulus of subgrade reaction (k) of 30 MPa/m may be used for the design of the floor slabs. The slab-on-grade floor should be independent of all load-bearing walls and columns.

5 STATEMENT OF LIMITATIONS

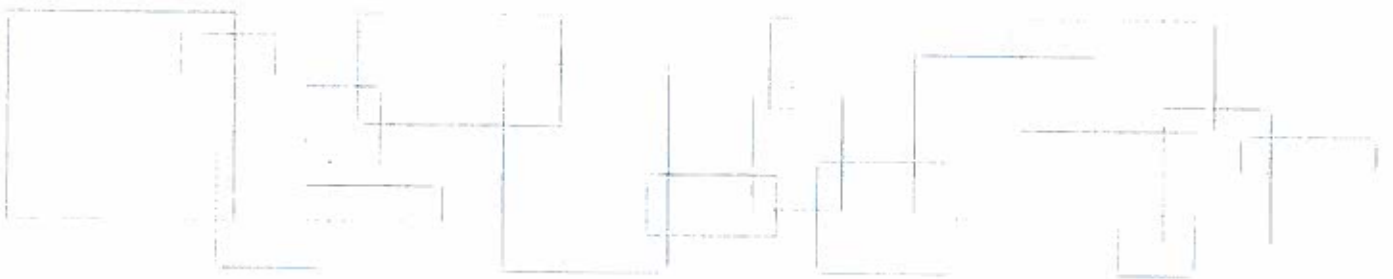
The geotechnical recommendations provided in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. We also recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the boreholes and to ensure that our recommendations are properly understood.

The geotechnical recommendations provided in this report are applicable only to the project described in the text and are intended for the use of the project designer. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

It is important to note that the geotechnical investigation involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered. The subsurface conditions between and beyond the boreholes will differ from those encountered at the test holes. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions.

Appendix 1 Borehole Logs

List of Abbreviations
Boreholes 101-11 to 106-11
Boreholes 21 and 22
(ENE 89G034)



LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	auger sample	SPT	Standard Penetration Test
CS	chunk sample	UC	unconfined compression
RC	rock core	FV	field vane test
SS	split spoon	ϕ	angle of internal friction
TW	thin-walled, open	γ	unit weight
WS	wash sample	w_p	plastic limit
		w	water content
		w_L	liquid limit
		I_L	liquidity index
		I_p	plasticity index
		PP	pocket penetrometer

Penetration Resistances

Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a 50 mm (2 in.) diameter 60 ° cone a distance 0.30 m (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 0.76 m (30 in.) required to drive a standard split spoon sampler 0.30 m (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description

Cohesionless Soils	SPT N-Value	D _r (%)
Relative Density (D_r)	(blows per 0.30 m)	
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	Undrained Shear Strength (C _u)	
Consistency	kPa	psf
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	
APL	About plastic limit	
WTPL	Wetter than plastic limit	



Borehole Number: 101-11

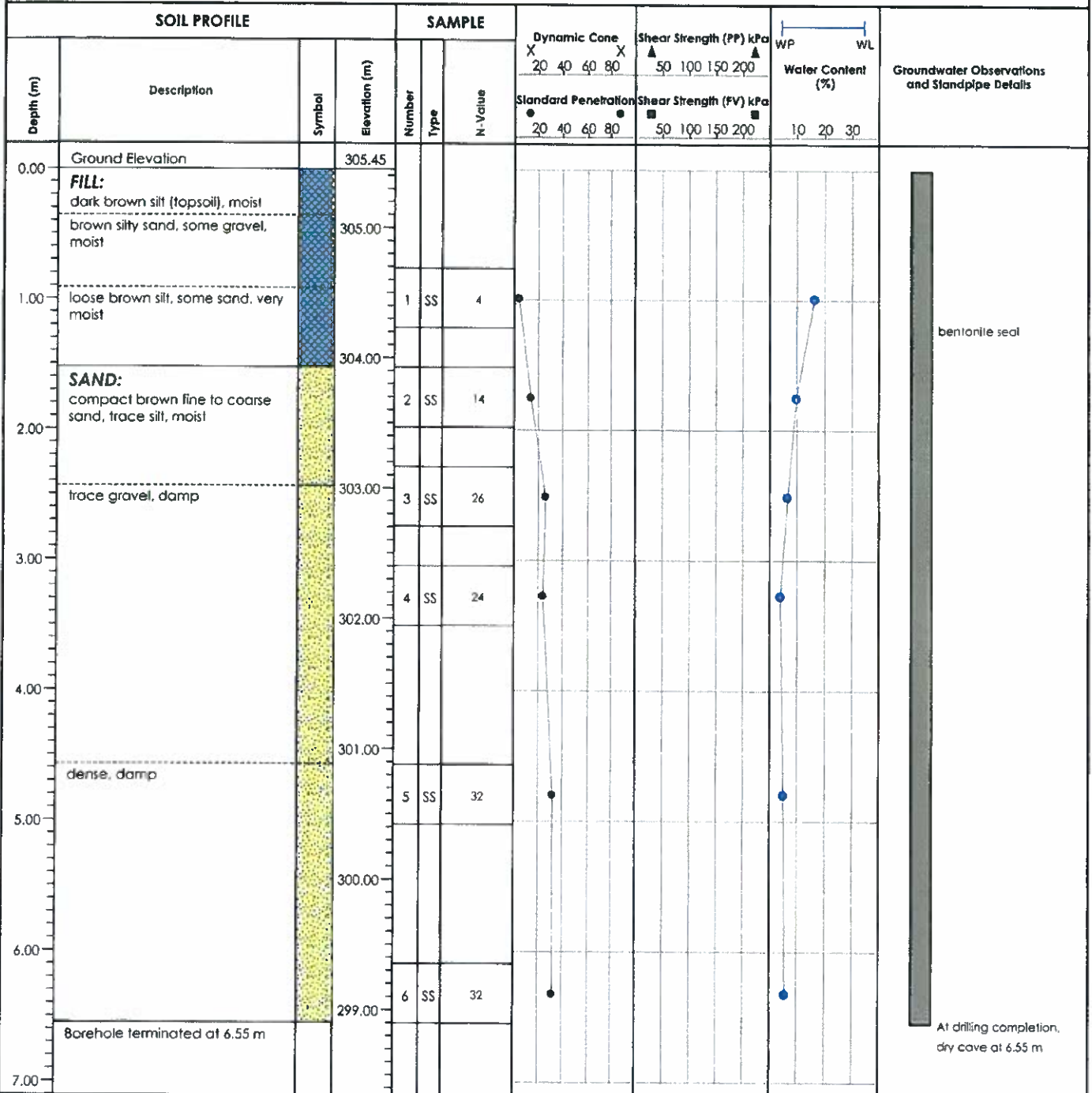
Ground Elevation: 305.45 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-21



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Meeter



Borehole Number: 102-11

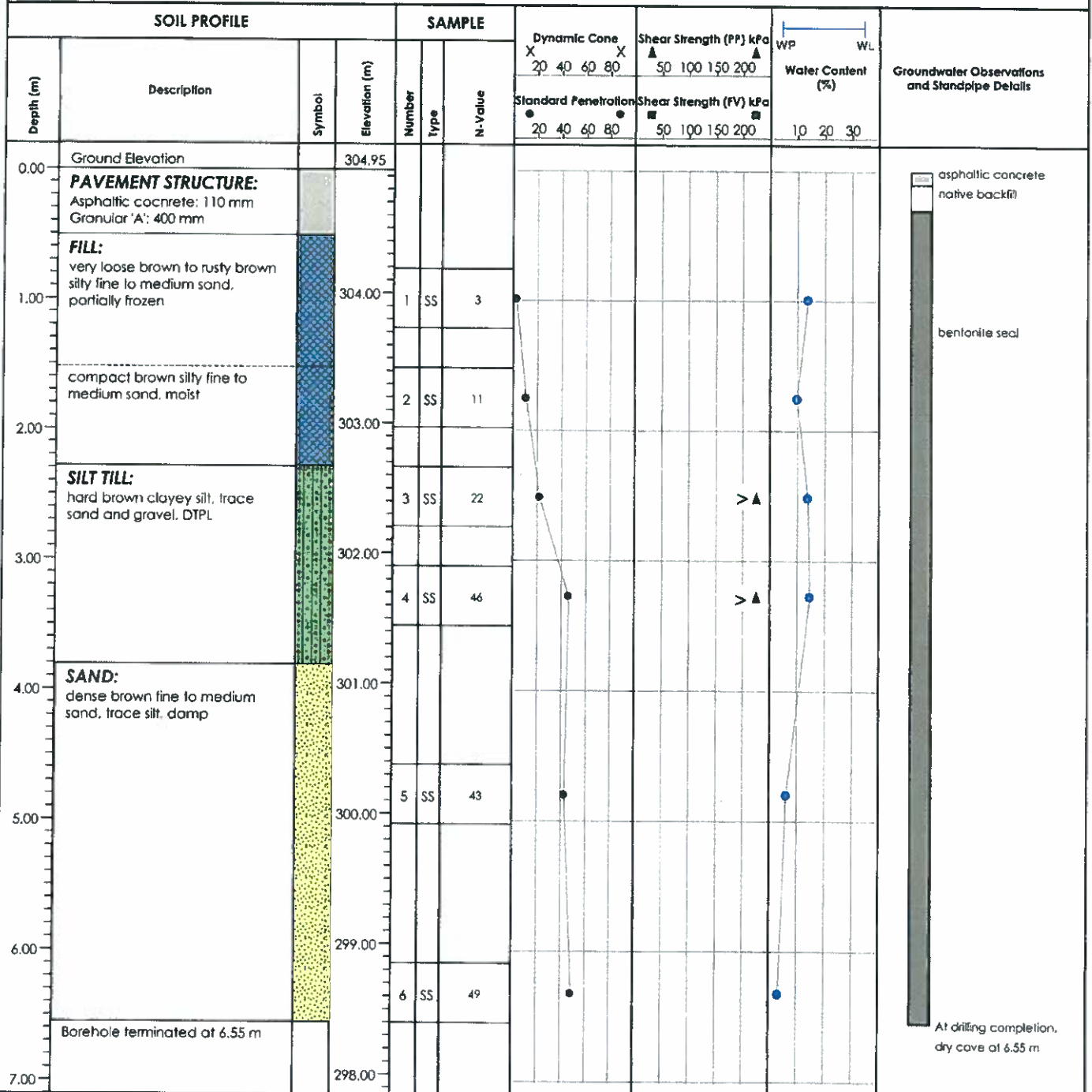
Ground Elevation: 304.95 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-21



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Mefer



Borehole Number: 103-11

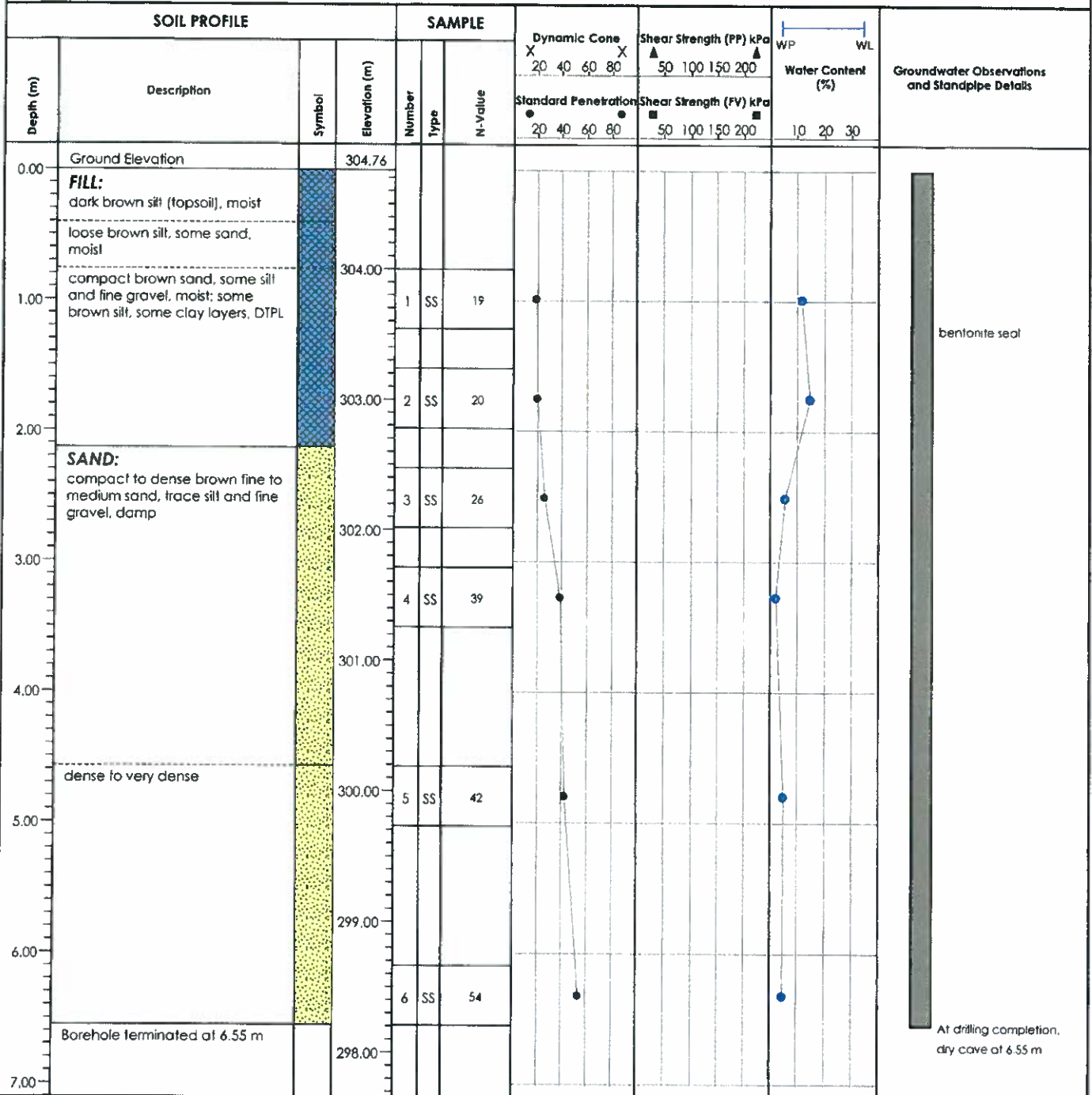
Ground Elevation: 304.76 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-21



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Mefer



Borehole Number: 104-11

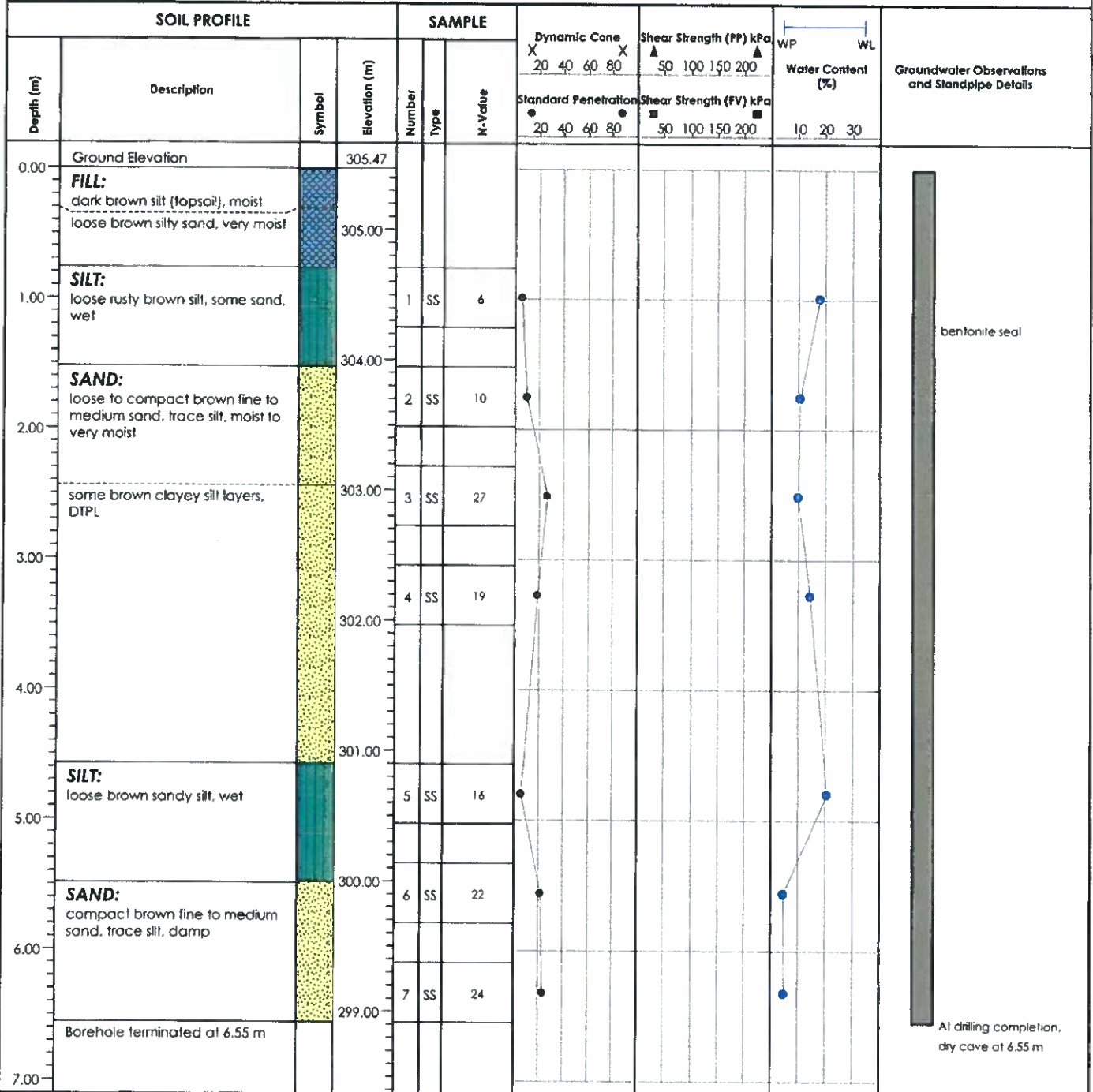
Ground Elevation: 305.47 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-21



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Mefer



Borehole Number: 105-11

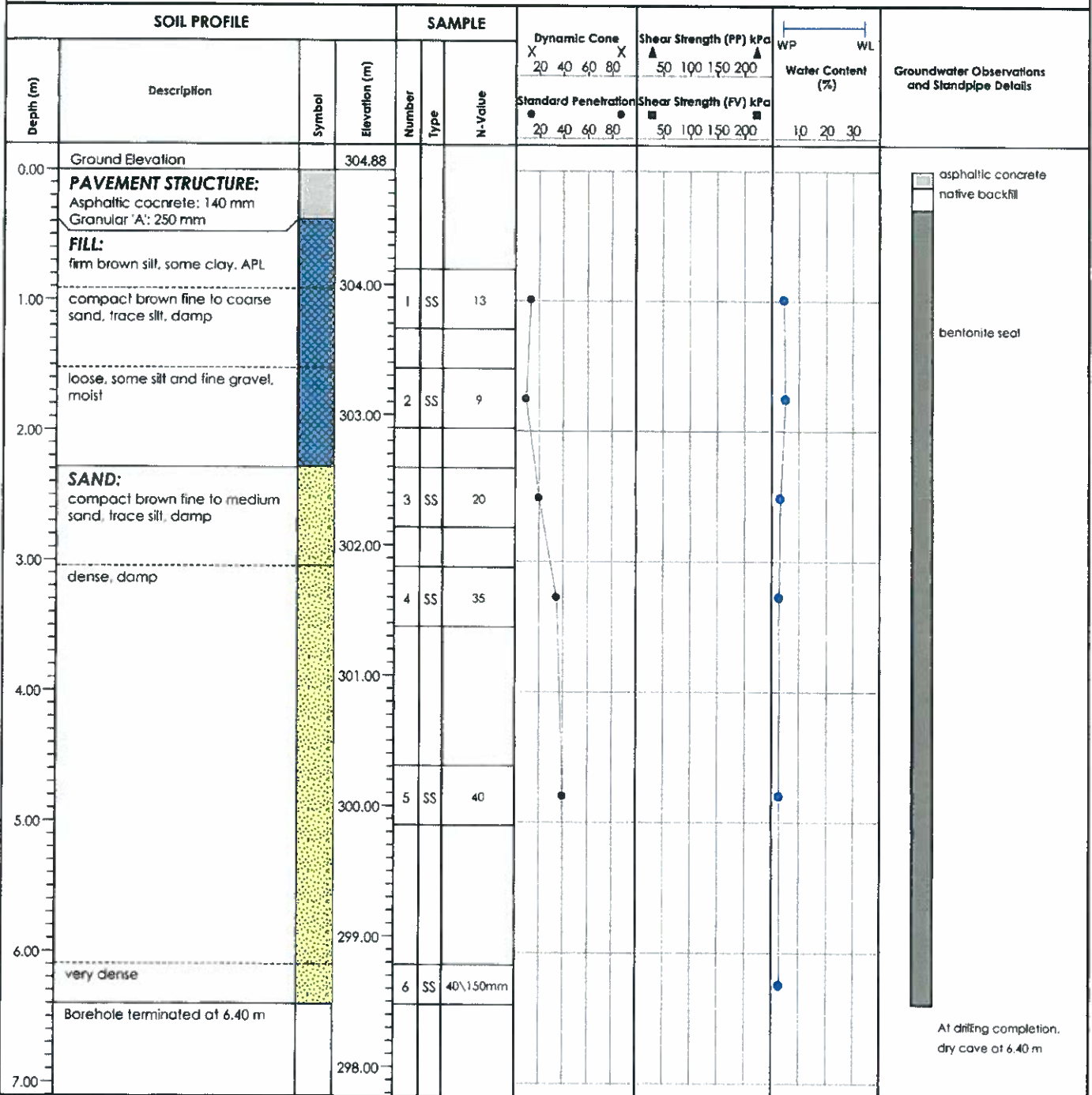
Ground Elevation: 304.88 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-22



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Meeter



Borehole Number: 106-11

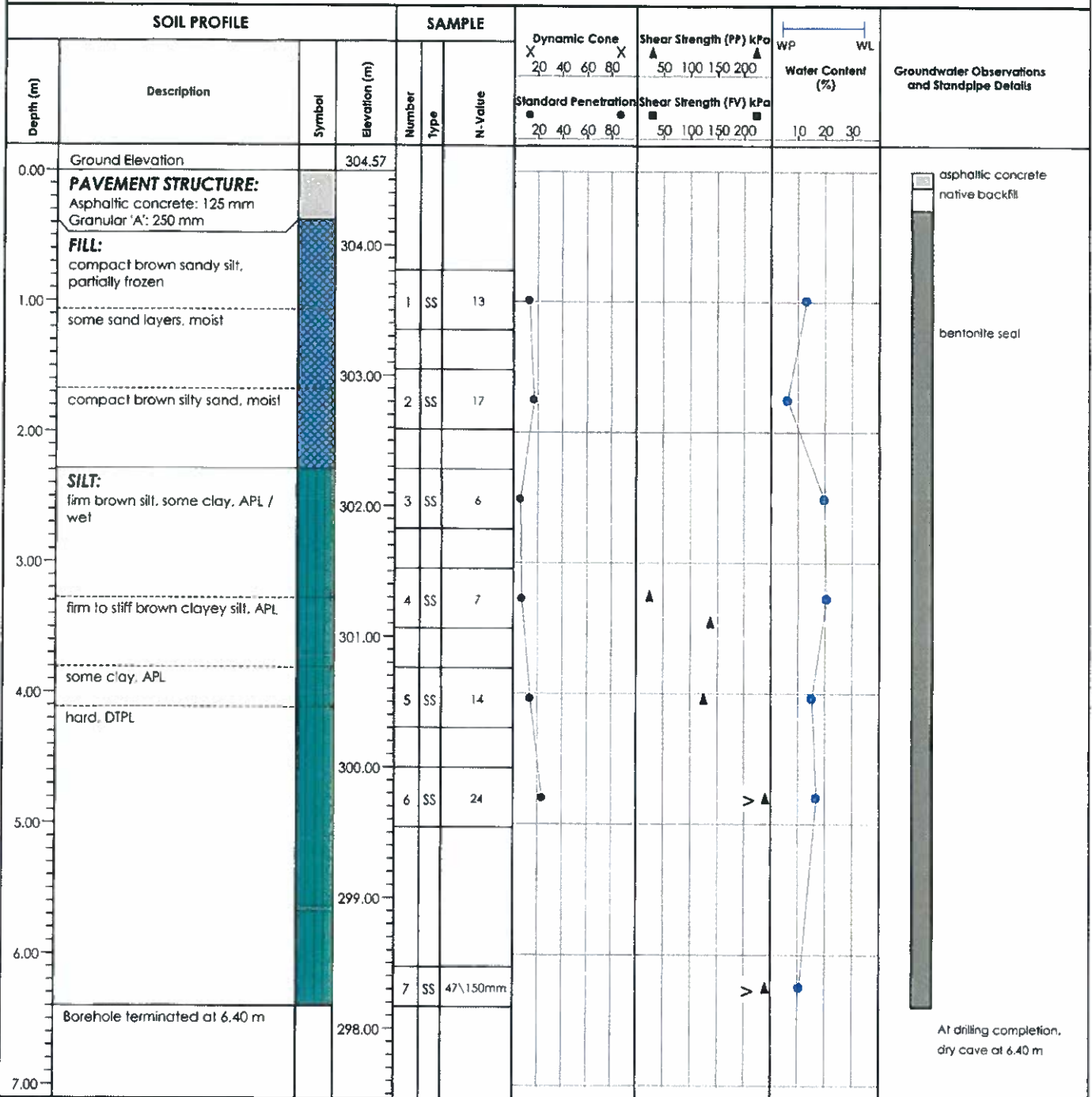
Ground Elevation: 304.57 m

Project: Grand Valley Institution - Principal Entrance Addition

Job No.: P038209-101

Location: 1575 Homer Watson Boulevard, Kitchener, Ontario

Drill Date: 2011-03-22



Reviewed by: K.Thrams
 Drill Method: Solid Stem Auger
 Notes:

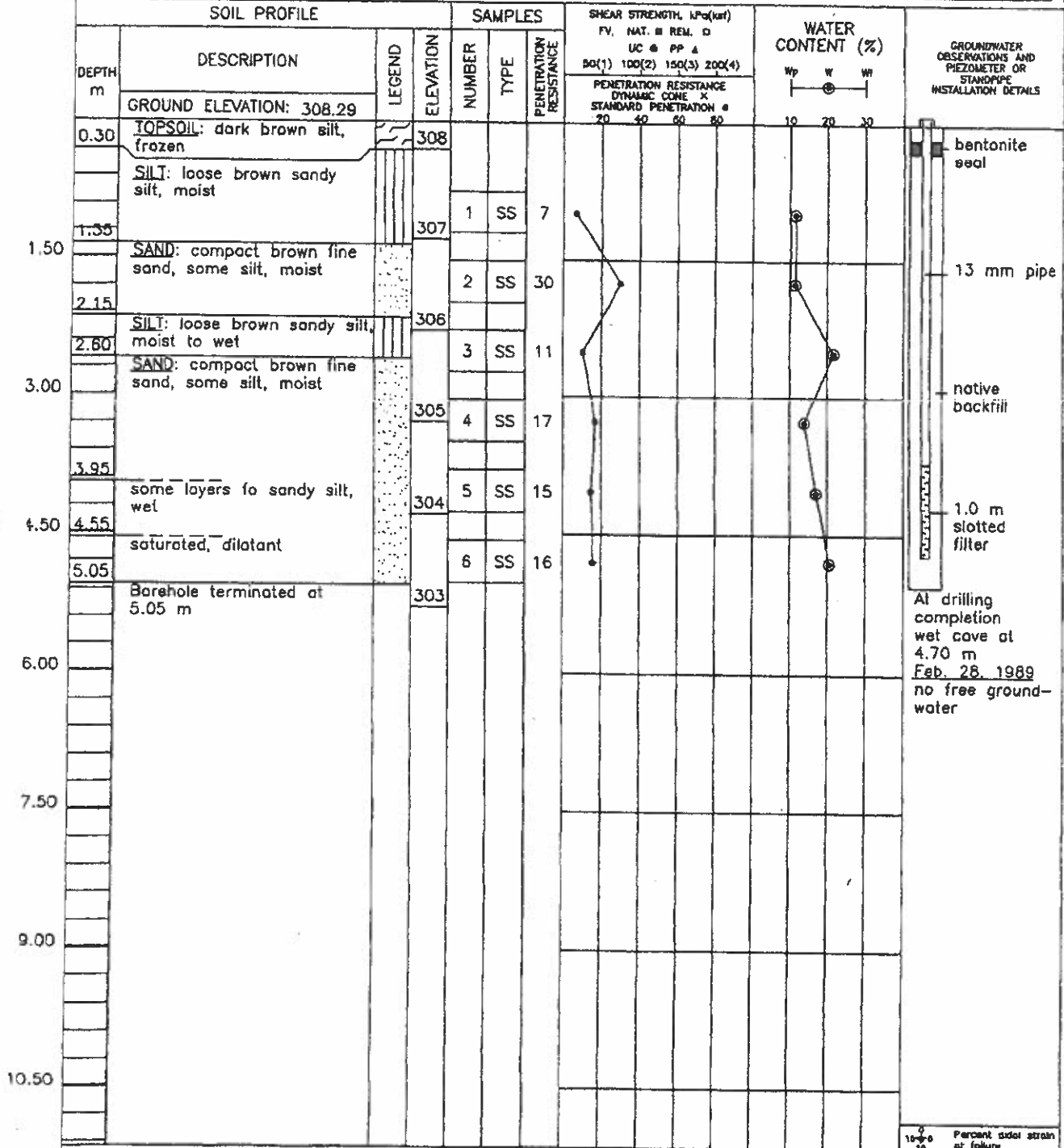
Field Tech.: R.McMillan
 Sheet: 1 of 1
 Drafted by: S.Mefer



ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING GEOTECHNICAL ENGINEERS

BOREHOLE NO. 21

PROJECT Property Option DATE Feb. 21, 1989 JOB NO. 89G034
LOCATION Homer Watson Boulevard and Manilou Drive, Kitchener FIELD ENG/TECH MD



NOTES:

DRILLING METHOD: Solid Stem Auger

ENGINEER: *[Signature]*

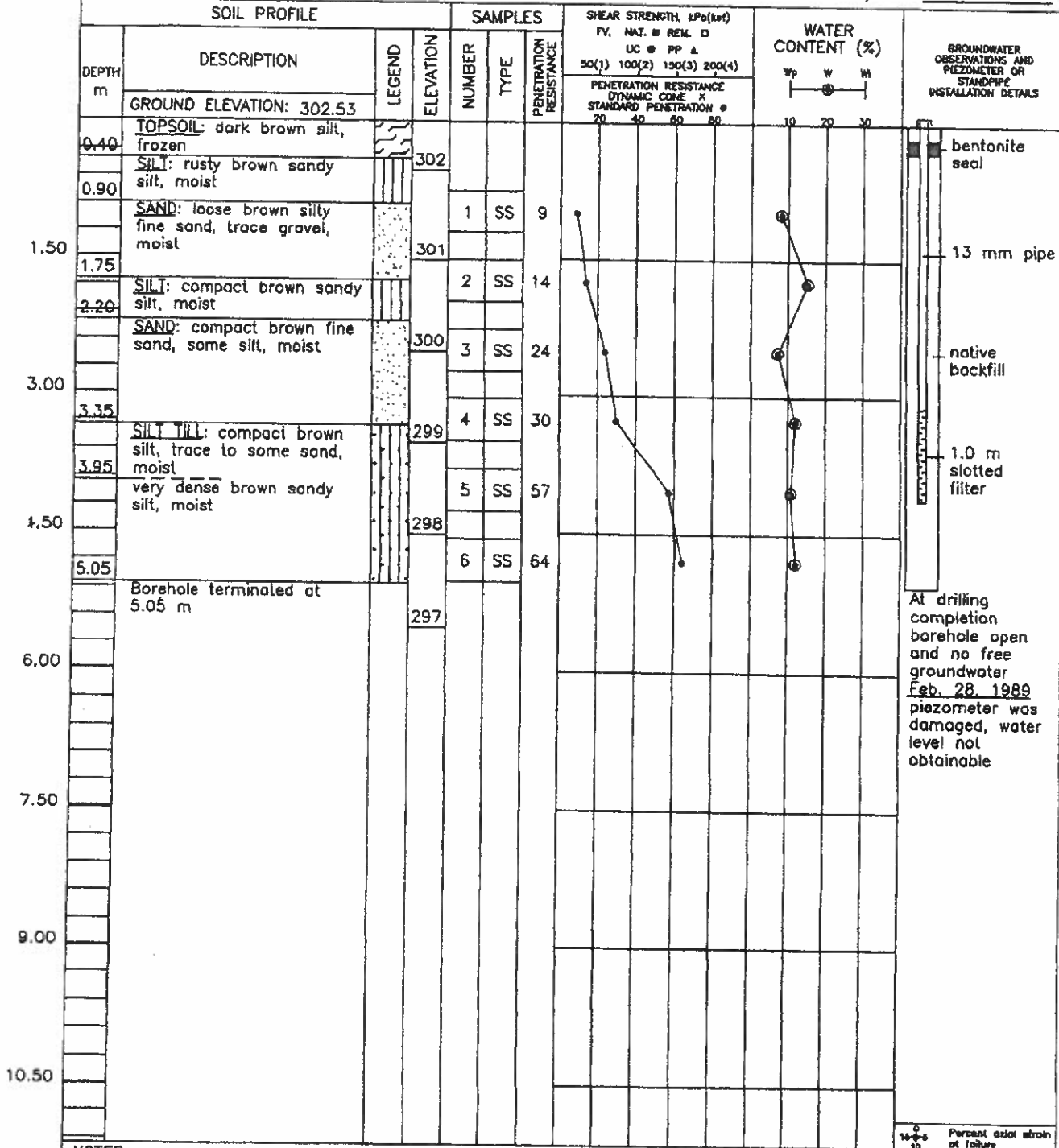
0
10-16
16 Percent axial strain at failure



ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING GEOTECHNICAL ENGINEERS

BOREHOLE NO. 22

PROJECT Property Option DATE Feb. 21, 1989 JOB NO. 89G034
LOCATION Homer Watson Boulevard and Manitou Drive, Kitchener FIELD ENG/TECH MD



At drilling completion borehole open and no free groundwater Feb. 28, 1989 piezometer was damaged, water level not obtainable

NOTES:

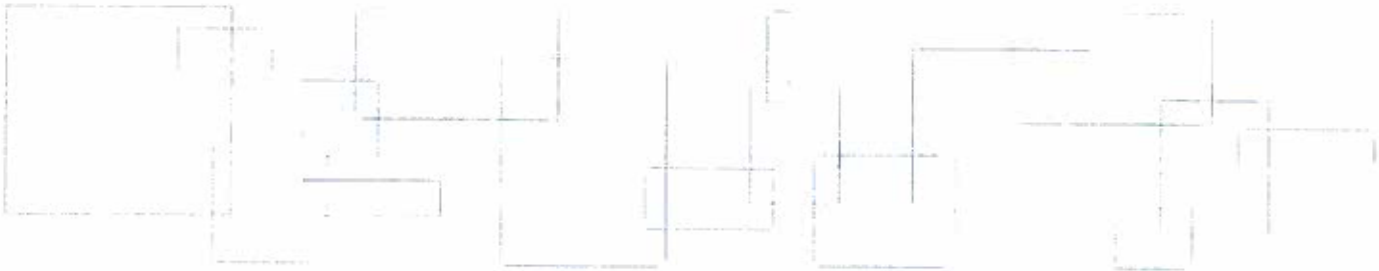
DRILLING METHOD: Solid Stem Auger

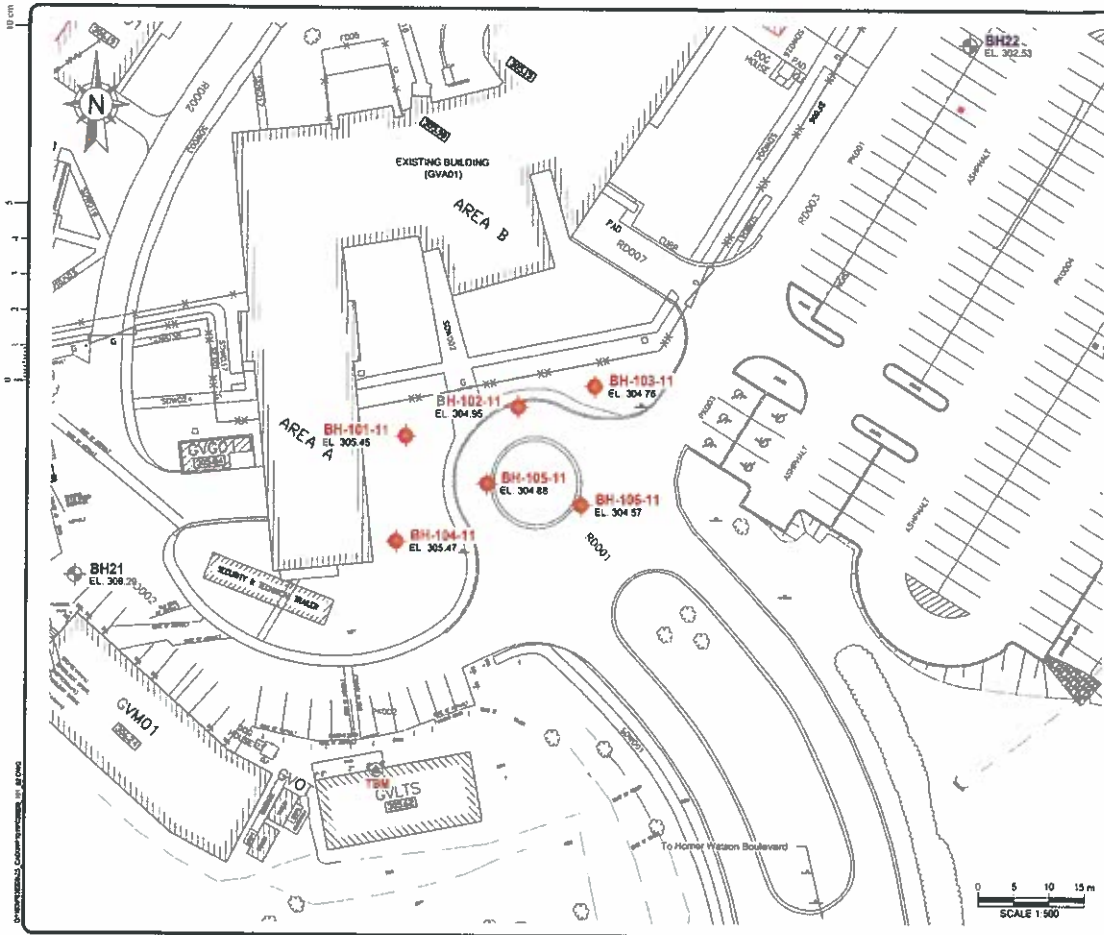
ENGINEER: *JOL*

0
10-30 Percent axial strain at failure

Appendix 2 Drawings

Drawing 1: Location Plan
Drawing 2: Site Plan





LEGEND

- ◆ BOREHOLE LOCATION
Current Investigation
- ◆ BOREHOLE LOCATION
Previous Investigation
ENE Ltd. 85G034, March 1999
- EL. 305.46 GROUND SURFACE ELEVATION (m)
- T.M. TEMPORARY BENCHMARK

NOTES

- 1-REFERENCES: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA, Site Services, 2011-03-02
- 2-BENCHMARK: Finished Floor at entrance to GVLTS Building. Elevation 305.62 m (geodetic)

**Grand Valley Institution
Principal Entrance Addition**

1170 Homer Watson Boulevard, Kitchener, Ontario

SITE PLAN

LVM		LVM INC 1170 Homer Watson Blvd Kitchener, Ontario N2H 2T5 Tel: 519-741-1111 Fax: 519-741-1122
Prepared by: S. Maitner	Checked by: S. Maitner	Drawn by: GEOTECHNICAL
Scale: 1:500	Date: 2011-03-31	Sheet No: 02 of 02
Project Manager: K. Thramas		Scale: 02 of 02
Job No: 160P038209	Project: 101	Disc: GE Drawing No: 02

10 cm

5

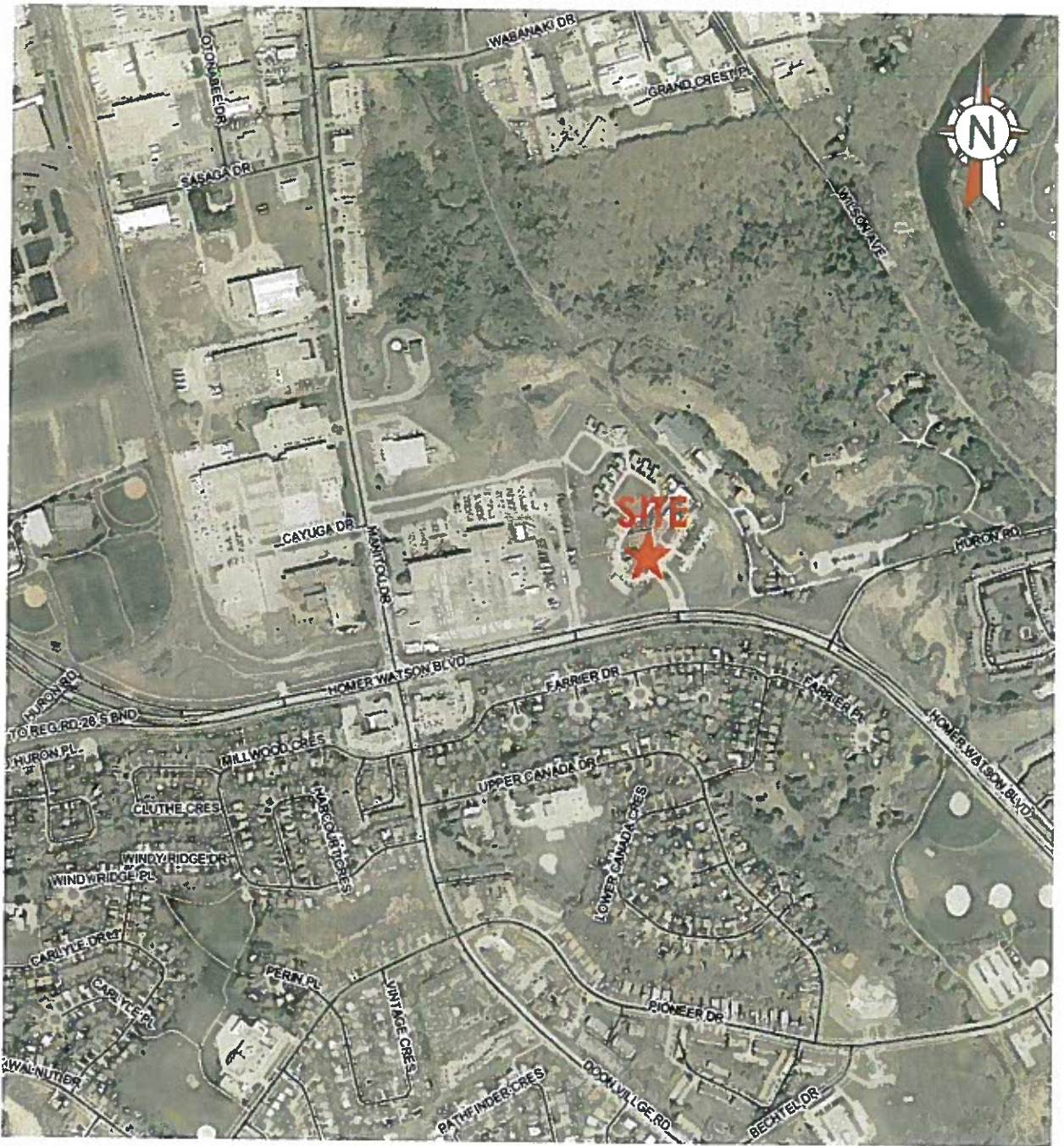
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NOTES :

1-REFERENCES : GRAND RIVER CONSERVATION
AUTHORITY, 2006 aerial imagery (2011).



SCALE 1:10000

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Project

Grand Valley Institution Principal Entrance Addition

1575 Huron Watson Boulevard, Kitchener, Ontario

Title

LOCATION PLAN



LVM inc.

353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared **S.Meteor**

Drawn **S.Meteor**

Checked **K.Thrams**

Discipline **GEOTECHNICAL**

Scale **1:10000**

Date **2011-03-22**

Project manager

K.Thrams

Sequence no.

01 of 02

M. dept.

160

Project

P038209

Work pkg.

101

Sub-w.p.

Disc.

GE

Drawing no.

01

Rev.

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