PROJECT TITLE Warkworth Ontario
Medium Security Institution
Underground Duct Replacement

PROJECT NUMBER R.033225.001

PROJECT DATE 2013-10-29

END

Consultant for Building Code Review: AECOM Canada Architects, LTD.

Building Code Designation Number (BCDN): Non-Applicable

Architect: Peter Lloyd Jones

Mechanical Engineer: David Dovas

Electrical Engineer: Jean Wang

LICENSED PROFESSIONAL ENGINEER
D. B. DOVAS
100178914
OCT 29/2013
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
H. J. WANG
100099672
OCT 29/2013
PROVINCE OF ONTARIO

ONTARIO ASSOCIATION OF ARCHITECTS
PETER LLOYD JONES
LICENCE
5131
2013.10.30

END

END

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises the upgrading of the HVAC system in buildings WW02, WW03, WW12, and WW15 at the Warkworth Medium Security Institution, and all work needed to support the upgrade.

.2 ACM is to be removed from building WW03 before upgrading work begins. Refer to Designated Substances and Harzardous Materials Survey (DSHMS) prepared by Decommissioning Consulting Services Ltd., April 2011. Refer to section 02 82 00.02.

.3 For buildings WW02, WW12, and WW15 known ACM is referenced by Designated Substances and Harzardous Materials Survey (DSHMS) prepared by XCG, March 30, 2003.Refer to section 02 82 00.02.

1.2 CONTRACT METHOD

.1 Construct work under lump sum contract.

1.3 COST BREAKDOWN

.1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract price.

.2 Show separately cost of equipment purchased exempt from Ontario Retail Sales Tax under your Ontario Sales Tax licence number.

.3 Within 48 hours of acceptance of bid submit a list of subcontractors.

1.4 WORK BY OTHERS

.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions fromDepartmental Representative.

.2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

1.5 WORK SEQUENCE

.1 Construct Work in stages to accommodate Owner's continued use of premises during construction.

.2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.

.3 Maintain fire access/control.

1.6 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for Work, for storage, and for access, to allow:
.1 Owner occupancy.
.2 Work by other contractors.

.2 Co-ordinate use of premises under direction of Departmental Representative.

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

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

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

.6 At completion of operations condition of existing work: eq6ual to or better than that which existed before new work started.

1.7 OWNER OCCUPANCY

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.8 ALTERATIONS ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.8 ALTERATIONS ADDITIONS OR REPAIRS TO EXISTING BUILDING (Cont'd)

.2 Use only elevators, dumbwaiters, conveyors or escalators existing in building for moving workers and material.

.1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.

.2 Accept liability for damage, safety of equipment and overloading of existing equipment.

1.9 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each document as follows:

.1 Contract Drawings.
.2 Specifications.
.3 Amendments
.4 Reviewed Shop Drawings.
.5 List of Outstanding Shop Drawings.
.6 Change Orders.
.7 Other Modifications to Contract.
.8 Field Test Reports.
.9 Copy of Approved Work Schedule.
.10 Other documents as specified.
.11 Material Safety Data Sheets.
.12 Labour and Material Bonds.
.13 All applicable Municipal Permits.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 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, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Provide for personnel traffic.

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

1.3 SPECIAL REQUIREMENTS

.1 Submit schedule in accordance with Section 01 32 16.07.

.2 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

.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 as 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 the supervision of Departmental Representative.
.6 Additional tests specified in the following paragraph.

.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 to be inspected and tested.
.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 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.

1.3 CONTRACTOR'S RESPONSIBILITIES (Cont'd)

.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

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 four days in advance of meeting date to Departmental Representative.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Representatives 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 16.07.
.3 Schedule of submission of shop drawings, samples, 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 Site security in accordance with Section 01 35 13.

1.2 PRECONSTRUCTION MEETING (Cont'd)

.5 Agenda to include:(Cont'd)
.6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
.7 Owner provided products.
.8 Record drawings in accordance with Section 01 33 00.
.9 Maintenance manuals in accordance with Section 01 78 00.
.10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.
.11 Monthly progress claims, administrative procedures, photographs, hold backs.
.12 Appointment of inspection and testing agencies or firms.
.13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

.1 During course of Work and 2 weeks prior to project completion, schedule progress meetings monthly.

.2 Contractor, major Subcontractors involved in Work and Departmental Representative and Owner are to be in attendance.

.3 Notify parties minimum 5 days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 days after meeting.

.5 Agenda to include the following:
.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress since previous meeting.
.3 Field observations, problems, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

1.3 PROGRESS MEETINGS (Cont'd)

.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

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 5 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:
.1 Award.
.2 Shop Drawings, Samples.

1.5 PROJECT SCHEDULE (Cont'd)

.2 (Cont'd)
.3 Permits.
.4 Mobilization.
.5 Siding and Roofing.
.6 Interior Architecture (Walls, Floors and Ceiling).
.7 Plumbing.
.8 Lighting.
.9 Electrical.
.10 Piping.
.11 Controls.
.12 Heating, Ventilating, and Air Conditioning.
.13 Millwork.
.14 Fire Systems.
.15 Testing and Commissioning.
.16 Supplied equipment long delivery items.
.17 Departmental Representative supplied equipment required dates.

1.6 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on weekly basis 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

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.

.11 Submit number of hard copies specified for each type and format of submittal and in also submit

1.1 ADMINISTRATIVE (Cont'd)

.11 (Cont'd)
in electronic format as pdf files. Forward pdf files on CD or through email.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 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.

.2 After Departmental Representative's review, distribute copies.

.3 Submit three hard copies and one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.4 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.

.5 Submit three hard copies and one electronic copy of test reports for requirements requested

1.2 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.5 (Cont'd)
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.

.6 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.

.7 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.

.8 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.

.9 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.10 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.

.11 Delete information not applicable to project.

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

.13 If upon review by Departmental Representative, no errors or omissions are discovered or if only

1.2 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.13 (Cont'd)
minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.14 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.

1.3 SAMPLES (Cont'd)

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 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.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

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, $25.00 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.

1.2 DEFINITIONS (Cont'd)

.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 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 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

1.4 CONSTRUCTION EMPLOYEES (Cont'd)

.3 (Cont'd)
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. 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.

.5 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.

1.6 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.

1.7 WORK HOURS

.1 Work hours within the Institution are: Monday to Friday 08:00 hrs to 16:00 hrs.
.1 Work in buildings WW02 will take place from 19:00 hrs to 06:00 hrs.

.2 Work will not be permitted during weekends and statutory holidays without the permission of the Departmental Representative. 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.

1.8 OVERTIME

.1 No overtime work will be allowed without permission of the Director. Give a minimum of 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.

1.8 OVERTIME (Cont'd)

.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.

1.9 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 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 If propane or natural gas is used for heating the construction, the Institution will require

1.9 TOOLS AND EQUIPMENT (Cont'd)

.8 (Cont'd)
that an employee of the Contractor supervise the construction site during non-working hours.

.9 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.

1.10 PRESCRIPTION DRUGS

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

1.11 SMOKING

.1 Smoking is prohibited anywhere on CSC property.
.1 Smoking only allowed in designated area of the parking lot.

.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 permitted outside the perimeter of a correctional facility only in areas designated by the Director.

1.12 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.

1.12 CONTRABAND (Cont'd)

.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.

1.13 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 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.

1.14 ACCESS TO AND REMOVAL FROM INSTITUTION PROPERTY

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

1.15 MOVEMENT

.1 Escorted commercial vehicles will be allowed to enter or leave the Institution through the vehicle access gate during the following hours:
.1 08:00 to 16:00, Monday to Friday.

.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.

1.15 MOVEMENT (Cont'd)

.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 No vehicle is permitted with more than one person (driver).

.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.

1.16 MOVEMENT OF EMPLOYEES ON INSTITUTIONAL PROPERTY

.1 Subject to the requirements of good security, CONSTRUCTION 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.

1.17 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

1.17 SURVEILLANCE AND INSPECTION (Cont'd)

.2 (Cont'd)
above, is established among Construction Employees and maintained throughout the construction project.

1.18 STOPPAGE OF WORK

.1 The Director may request at any time that the Contractor, his employees, sub-contractors and 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.

1.19 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.

1.20 COMPLETION OF CONSTRUCTION PROJECTS

.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.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA):
.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 Workplace Safety and Insurance Act, 1997.
.3 Municipal statutes and authorities.

.5 Fire Commissioner of Canada (FCC):
.1 FC-301 Standard for Construction Operations, June 1982.
.2 FC-302 Standard for Welding and Cutting, June 1982.

.6 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&section=text.

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 Measures and controls to be implemented to address identified safety hazards and risks.
.4 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to

1.2 SUBMITTALS (Cont'd)

.2 (Cont'd)

.4 (Cont'd)

commencement of work. The plan shall be coordinated with, and integrated into the existing Facility's Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Facility Emergency Procedures and Evacuation Plan. Deliver two copies of the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.

.5 Contractor's and Sub-contractors' Safety Communication Plan.

.6 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Facility's Emergency Response requirements and procedures provided by Departmental Representative.

.3 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.

.4 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.

.5 Submit names of personnel and alternates responsible for site safety and health.

.6 Submit records of Contractor's Health and Safety meetings when requested.

.7 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.

.8 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.

.9 Submit copies of incident and accident reports.

.10 Submit Material Safety Data Sheets (MSDS) in accordance with Section 01 11 00.

1.2 SUBMITTALS (Cont'd)

.11 Submit Workplace Safety and Insurance Board (WSIB)- Experience Rating Report.

1.3 FILING OF NOTICE

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

1.4 WORK PERMIT

.1 Obtain building permits related to project prior to commencement of Work.

.2 Obtain Hot Work Permit from Chief Plant Maintenance.

1.5 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.6 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 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.

1.8 PROJECT/SITE CONDITIONS

.1 For Building WW03, refer to Designated Substances and Hazardous Materials Survey (DSHMS) prepared by Decommissioning Consulting Services Ltd., April 2011.

.2 For Buildings WW02, WW12, and WW15 refer to Designated Substances and Hazardous Materials Survey (DSHMS) prepared by XCG, March 30, 2003.

.3 DSHMS documants available from Departmental Representative on request.

1.9 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.

.3 Relief from or substitution for any portion or provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.10 COMPLIANCE REQUIREMENTS

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

1.11 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.

1.12 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.

1.13 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 Contractor's Safety Policy.
.2 Constructor's Name.
.3 Notice of Project.
.4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
.5 Ministry of Labour Orders and reports.
.6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.
.7 Address and phone number of nearest Ministry of Labour office.
.8 Material Safety Data Sheets.
.9 Written emergency Response Plan.
.10 Site Specific Safety Plan.
.11 Valid certificate of first aider on duty.
.12 WSIB "In Case of Injury At Work" poster.
.13 Location of toilet and cleanup facilities.

1.14 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.

1.15 BLASTING

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

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.

.2 Assign responsibility and obligation to Competent Supervisor to stop or start Work when, at Competent Supervisor's discretion, it is necessary or advisable for reasons of health or

1.16 WORK STOPPAGE (Cont'd)

.2 (Cont'd)
safety. Departmental Representative may also stop Work for health and safety considerations.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

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, other than those identified is section 01 35 29.06 are discovered in course of work.

1.3 RELICS AND ANTIQUITIES

.1 Relics and antiquities, and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tables, and similar objects found on site shall remain the property of Parks Canada. Protect such articles and request directives from Departmental Representative.

1.4 IAQ - INDOOR AIR QUALITY

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

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.

1.5 STATISTICAL INFORMATION (Cont'd)

.2 Include in statistical information:(Cont'd)
.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 m^2 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

PART 1 - GENERAL

1.1 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.

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.3 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.

1.4 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.

1.5 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 Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.6 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.

1.7 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.

1.8 MILL TESTS

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

1.9 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

PART 1 - GENERAL

1.1 SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.3 DEWATERING

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

1.4 WATER SUPPLY

.1 Departmental Representative will 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 Departmental Representative will pay for utility charges at prevailing rates.

1.5 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.

1.5 TEMPORARY HEATING AND VENTILATION (Cont'd)

.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 Use of new permanent hydronic heating systems for supplying temporary heat is permitted only under following conditions:
.1 Use of the Hydronic system is approved by the Departmental representative
.2 Entire system is complete, pressure tested, cleaned, flushed out.
.3 Existing water treatment systems are being continuously monitored.
.4 Building has been closed in, areas to be heated are clean and will not thereafter be subjected to dust-producing processes.
.5 There is no possibility of damage.
.6 Systems will be:
.1 Operated as per manufacturer's recommendations and instructions.
.2 Operated by Contractor.
.3 Monitored continuously by Contractor.
.7 Warranties and guarantees are not relaxed.
.8 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
.9 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition.

.7 Departmental Representative will pay utility charges when temporary heat source is existing building equipment.

1.5 TEMPORARY HEATING AND VENTILATION (Cont'd)

.8 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.

.9 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER AND LIGHT

.1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.

.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.

1.7 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of Work required by 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 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB 1.189-2000, Exterior Alkyd Primer for Wood.
.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.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-0121-08, Douglas Fir Plywood.
.3 CAN/CSA-S269.2-M87(R2003), Access Scaffolding for Construction Purposes.
.4 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment.

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 CAN/CSA-S269.2.

.2 Provide and maintain all scaffolding, ramps, ladders, platforms, and temporary stairs.

1.5 HOISTING

.1 Provide, operate and maintain hoists/cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for 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 permitted on site in accordance with section 01 35 13.

.2 Provide and maintain adequate access to project site.

.3 Build and maintain temporary roads where indicated or directed by Departmental Representative and provide snow removal during period of Work.

.4 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

.5 Clean construction runways and taxi 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 Subcontractor offices are to be shared with the contractor. Direct location of these offices.

.4 Install electrical lighting system to provide min 750 lx using surface mounted, shielded

1.8 OFFICES (Cont'd)

.4 (Cont'd)
commercial fixtures with 10% upward light component.

.5 Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue.

.6 Maintain in clean condition.

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 See section 01 35 13.

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.

.3 Permanent facilities may be used on approval of Departmental Representative.

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 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.2 Dust control: adequate to ensure safe operation at all times.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC (Cont'd)

.3 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.

.4 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.5 Provide snow removal during period of Work.

.6 Remove, upon completion of work, haul roads designated by Departmental Representative.

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 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB):
.1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
.2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA):
.1 CSA-O121-08, 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 new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m o.c. Provide one lockable truck gate. Maintain fence in good repair.

.2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.4 ACCESS TO SITE

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

1.5 PUBLIC TRAFFIC FLOW

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

1.6 FIRE ROUTES

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

1.7 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

.2 Be responsible for damage incurred.

1.8 PROTECTION OF BUILDING FINISHES

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

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with 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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control.

1.2 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.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

.6 OPSS Ontario Provincial Standard Specifications and OPSD Ontario Provincial Standard Drawings quoted in these specifications are available online at http://www.raqsa.mto.gov.on.ca/ techpubs/ops.nsf/OPSHomepage.

1.3 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

1.3 QUALITY (Cont'd)

.2 (Cont'd)
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.

1.4 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.

1.5 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.

1.5 STORAGE, HANDLING AND PROTECTION (Cont'd)

.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.

1.6 TRANSPORTATION

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

.2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

1.7 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

1.7 MANUFACTURER'S INSTRUCTIONS (Cont'd)

.3 (Cont'd)
re-installation at no increase in Contract Price or Contract Time.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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.

1.13 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.14 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No.304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.15 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.

1.16 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants.

.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

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.

1.3 PREPARATION (Cont'd)

.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 including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Remove samples of installed Work for testing

.6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.10 Restore work with new products in accordance with requirements of Contract Documents.

.11 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.12 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

1.4 EXECUTION (Cont'd)

.13 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element, in accordance with ULC standards.

.14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

.1 General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
.1 Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

.2 Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed to the weather during cutting and patching operations.

.3 Do not cut and patch elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

.4 Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction

3.1 CUTTING AND PATCHING (Cont'd)

.4 (Cont'd)
exposed on the exterior or in occupied spaces in a manner that would, in the Departmental Representative's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

.5 Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.
.1 In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
.2 Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
.3 Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

.6 Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible.
.1 Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
.2 Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
.1 Clean piping, conduit, and similar features before applying paint or other finishing materials.
.2 Restore damaged pipe covering to its original condition.
.3 Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if

3.1 CUTTING AND PATCHING (Cont'd)

.6 Patching:(Cont'd)

.3 Floors and Walls:(Cont'd)

necessary, to achieve uniform color and appearance.

.1 Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

.4 Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

.5 Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition

.7 Roofs: Prepare existing roof for receipt of new work. Ensure existing system is not damaged by preparation work. Remove only areas of the existing roofing system which can be replaced, complete with membrane flashings, on the same day. Tie-in new work with existing roofing system in accordance with the manufacturer's recommendations for the products used. All products to be compatible with the existing roof system components.

.1 Roofing and Flashings: New materials, same as and matching materials used in the existing roof system. Install in accordance with manufacturers' instructions.

.2 Curbs: Install curbs required for new work.

.3 All work shall meet the requirements of the Canadian Roofing Contractors Association (CRCA.), including all amendments up to project date.

.4 Applicators: Member in good standing of the Canadian Roofing Contractors Association and which has a minimum of 5 years of proven satisfactory experience.

.5 Existing Warranties, if Any: Remove, replace, patch, and repair materials and surfaces cut or damaged during work, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.

.1 Notify warrantor of existing roofing system on completion of work, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at project closeout.

3.2 NEW AND REPLACEMENT WORK

.1 Make good materials, and prepare surfaces and refinish all finished surfaces damaged, marred, replaced, or otherwise remedied in the existing building

.2 Preparation for new finishes:
.1 Remove existing finishes, including painting.
.2 Fill cracks and depressions with suitable filler and finish smooth, as recommended by the manufacturer of the new finishes.
.3 Grind protrusions level with substrates and finish smooth.
.4 Remove all evidences of existing adhesive, grease, oil, soil and other encrustations of foreign material by washing, scraping and grinding if necessary.
.5 Clean and prepare substrates to receive new work.

.3 Finish new surfaces flush with existing surfaces. Make junctions between existing and new work, or at replaced or remedial work indistinguishable. Make surfaces adjacent to one another of the same material, unit sizes, colour, and texture. If this is impossible, make a proposal of intended method of making good for the Departmental Representative's approval, before installation.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Progressive cleaning.

.2 Final cleaning.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner 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 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 20.

.7 Remove waste material and debris from site and deposit in waste container at end of each working day.

.8 Dispose of waste materials and debris off site.

.9 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.10 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

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

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

1.2 PROJECT CLEANLINESS (Cont'd)

.13 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

.1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by Owner 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, and floors.

.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.

1.3 FINAL CLEANING (Cont'd)

.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

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 50 % 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.

.3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.

.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

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 are fully operational.
.4 Certificates required by Fire Commissioner 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

PART 1 - GENERAL

1.1 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.

1.2 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, process flow, under Section numbers and sequence of Table of Contents.

1.2 FORMAT (Cont'd)

.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.

1.3 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.

1.4 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.

1.4 AS-BUILTS AND SAMPLES (Cont'd)

.1 (Cont'd)
.4 Change Orders and other modifications to the Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.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.

.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".

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, 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.

1.5 RECORDING ACTUAL SITE CONDITIONS (Cont'd)

.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.

1.6 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01 33 00, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.7 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.

1.7 EQUIPMENT AND SYSTEMS (Cont'd)

.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.

1.8 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.

1.8 MATERIALS AND FINISHES (Cont'd)

.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.

1.9 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.

1.10 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.

1.11 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.

1.12 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.

1.13 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 Owner'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.

1.13 WARRANTIES AND BONDS (Cont'd)

.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

PART 1 - GENERAL

1.1 DESCRIPTION

.1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of interim completion.

.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 Equipment has been inspected and put into operation.

.2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 00 and equipment and systems are fully operational.

.3 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 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.

1.6 TIME ALLOCATED FOR INSTRUCTIONS

.1 Ensure amount of time required for instruction of each item of equipment or system as follows:
.1 Division 21 - Plumbing System: 4 hours of instruction.
.2 Division 23 - HVAC System: 8 hours of instruction.
.3 Division 26 - Electrical System: 4 hours of instruction.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

.1 Co-operate with System Commissioning Administrator under provisions specified in Section 01 45 00.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.2 REFERENCES

.1 ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process.

.2 ASHRAE Guideline 4-2008, Preparation of Operating and Maintenance Documentation for Building System.

.3 NEBB Procedural Standards for Building Systems Commissioning (1999).

1.3 SUBMITTALS

.1 Submit documentation to confirm Contractor personnel compliance with quality assurance provision.

.2 Submit 3 preliminary specimen copies of each type of startup checklist, product information and performance verification report forms proposed for use.

.3 Submit completed report forms within 3 days after completion of each testing to Departmental Representative for review and verification.

.4 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms for functional performance verification.

.5 Submit post-commissioning reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.4 REPORT FORMS

.1 System Commissioning Administrator shall make reports.

.2 Report forms shall include:
.1 Startup Checklists.
.2 Product Information (PI) Report forms.
.3 Performance Verification (PV) Report forms.

.3 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.4 Submit signed form to Departmental Representative for review, approval and signature.

.5 Identify each instrument used for testing, adjusting and balancing and its latest date of calibration.

1.5 CONTRACTOR'S RESPONSIBILITIES

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization and Departmental Representative 7 days prior to time project will be ready for testing, adjusting, and balancing.

.5 Accurately record data for each step.

.6 Report to Departmental Representative any deficiencies or defects noted during performance of services.

.7 Correct deficiencies identified in accordance with Departmental Representative's written instructions.

1.6 PREPARATION

.1 Make instruments available to Departmental Representative to facilitate spot checks during testing and functional performance verification.

.2 Retain possession of instruments and remove at completion of services.

1.6 PREPARATION (Cont'd)

.3 Verify systems installation is complete and in continuous operation.

1.7 EXECUTION

.1 Test hydronic systems, adjust and record liquid flow at each piece of equipment.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END

PART 1 - GENERAL

1.1 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.2 INSTRUCTORS

.1 Departmental Representative will provide:
.1 Descriptions of systems.
.2 Instruction on design philosophy, design criteria, and design intent.

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

.3 Contractor and equipment manufacturer to provide instruction on:
.1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.3 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:
.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

1.3 TRAINING OBJECTIVES (Cont'd)

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.4 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:
- .1 "As-Built" Contract Documents.
- .2 Operating Manual.
- .3 Maintenance Manual.
- .4 Management Manual.
- .5 TAB and PV Reports.

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

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

.5 Supplement training materials:
- .1 Transparencies for overhead projectors.
- .2 Multimedia presentations.
- .3 Manufacturer's training videos.
- .4 Equipment models.

1.5 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

.3 Training to be completed prior to acceptance of facility.

1.6 RESPONSIBILITIES

.1 Be responsible for:
- .1 Implementation of training activities,
- .2 Coordination among instructors,
- .3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

1.7 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:
.1 Review of facility and occupancy profile.
.2 Functional requirements.
.3 System philosophy, limitations of systems and emergency procedures.
.4 Review of system layout, equipment, components and controls.
.5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
.7 Maintenance and servicing.
.8 Trouble-shooting diagnosis.
.9 Inter-action among systems during integrated operation.
.10 Review of O&M documentation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.8 VIDEO-BASED TRAINING

.1 Manufacturer's videotapes/DVDs/Blu-ray to be used as training tool with Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.

.2 On-Site training videos:
.1 Videotape or record training sessions for use during future training.
.2 To be performed after systems are fully commissioned.
.3 Organize into several short modules to permit incorporation of changes.

.3 Production methods to be high quality.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Methods and procedures for deconstruction of structures and parts of structures.

1.2 REFERENCES

.1 Canadian Council of Ministers of the Environment (CCME).
.1 CCME PN1326-2009, Environmental Code of Practice for Aboveground and Underground Tank Systems Containing Petroleum Products and Allied Petroleum Products.

.2 Canadian Standards Association (CSA International).
.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.3 Federal Legislation.
.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.

1.3 DEFINITIONS

.1 Deconstruction: systematic dismantling of structure in a manner that achieves safe removal/disposal of hazardous materials and maximum salvage/recycling of materials.
.1 Ultimate objective is to recover potentially valuable resources while diverting from landfill what has traditionally been significant portion of waste system.

.2 Demolition: rapid destruction of structure with or without prior removal of hazardous materials.

.3 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health, well being or environment if handled improperly.

.4 Source Separation: acts of keeping different types of waste materials separate, beginning from first time they became waste.

.5 Waste Management Coordinator (WMC): contractor

representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 11 01 and 01 33 00.

.2 Submit pre-demolition audit and deconstruction/ disassembly plan prior to starting work in accordance with Division 1.

.3 Submit certified used building material receipts from authorized disposal sites and reuse and recycling facilities for material removed from site to Departmental Representative upon request.
.1 Written authorization from Departmental Representative is required to deviate from receiving organizations listed in Waste Reduction Workplan.

.4 Include following information:
.1 Time and date of removal.
.2 Description of material[s].
.3 Quantity of material.
.4 Breakdown of reuse, recycling and landfill quantities.
.5 End destination of materials.

.5 Workers, haulers and subcontractors must possess current, applicable permits to remove, handle and dispose of wastes categorized Municipally as hazardous.
.1 Provide proof of compliance within 24 hours upon written request of Departmental Representative.

1.5 QUALITY ASSURANCE

.1 Ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable provincial regulations.

1.6 STORAGE, HANDLING AND PROTECTION

.1 Do in accordance with Division 1.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Do Work in accordance with Division 1.

.2 Work of this Contract comprises the upgrading of the HVAC system in buildings WW02, WW03, WW12, and WW15 at the Warkworth Medium Security Institution, and all work needed to support the upgrade.

.3 ACM is to be removed from building WW03 before upgrading work begins. Refer to Designated Substances and Hazardous Materials Survey (DSHMS) prepared by Decommissioning Consulting Services Ltd., April 2011. Refer to section 02 82 00.02.

.4 For building WW02, WW12, and WW15 known ACM is referenced by Designated Substances and Hazardous Materials Survey (DSHMS) prepared by 02 82 00.02.

1.8 SITE CONDITIONS

.1 Existing Conditions.

.1 Should materials resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of deconstruction, stop work, take preventative measures, and notify Departmental Representative immediately. Do not proceed until written instructions have been received.

.2 Protection.

.1 Prevent movement, settlement or damage of adjacent structures and service. Provide bracing as required. Repair damage caused by deconstruction as directed by Departmental Representative.

.2 Support affected structures and, if safety of structure being deconstructed or adjacent structures appears to be endangered, take preventative measures. Cease operations and immediately notify Departmental Representative.

.3 Prevent debris from blocking surface drainage system, mechanical and electrical systems.

PART 2 - PRODUCTS

2.1 EQUIPMENT

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

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

.1 Determine if Environmental Assessment (EA) is required under requirements of CEAA.

.1 If necessary, employ licensed consultant to perform EA.

.2 Communicate findings and conclusions in writing to Departmental Representative prior to start of Work.

3.2 PREPARATION

.1 Do Work in accordance with Division 1.

.2 Locate and protect utility lines. Do not disrupt active or energized utilities.

3.3 REMOVAL OF HAZARDOUS WASTES

.1 Prior to start of deconstruction work remove contaminated or hazardous materials as directed by Departmental Representative from site and dispose of at designated disposal facilities in safe manner in accordance with TDGA and other applicable regulatory requirements, in accordance with Section 02 82 00.02.

3.4 DISASSEMBLY

.1 Materials removed from designated structure are property of Departmental Representative.

.2 Throughout course of deconstruction pay close attention to connections and material assemblies. Employ workmanship procedures which minimize damage to materials and equipment.

.3 Ensure workers and subcontractors are trained to carry out work in accordance with appropriate deconstruction techniques.

.4 Project supervisor with previous deconstruction experience must be present on site throughout project.

.5 Deconstruct in accordance with CSA S350 and other applicable safety standards.

.6 Workers must utilize certified harness and belay systems where Departmental Representative considers it necessary.

.7 Maintain structural integrity of structure.

.8 Systematically remove finishes, furnishings, and mechanical and electrical equipment as indicated.

.9 Wherever possible, transfer material assemblies from heights to ground level for easier disassembly. Take appropriate measures to ensure safety.

.10 Separate from waste stream, material designated for alternate disposal.

.11 Source separate for recycling materials that cannot be salvaged for reuse including wood, metal, concrete and asphalt.

.12 Remove materials that cannot be salvaged for reuse or recycling and dispose of in accordance with applicable codes at licensed facilities.

.13 Where existing materials are to be re-used in Work, use special care in removal, handling, storage and re-installation to assure proper function in completed work.

3.7 REMOVAL FROM SITE

.1 Transport material designated for alternate disposal by approved haulers listed in waste reduction workplan and in accordance with applicable regulations. Do not deviate from haulers listed in waste reduction workplan without prior written authorization from Departmental Representative.

.2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations. Disposal facilities must be approved of and listed in waste reduction workplan. Do not deviate from disposal facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.

3.8 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout deconstruction.

.2 Upon completion of project, remove debris, trim surfaces and leave work site clean.

.3 Upon completion of project, reinstate areas affected by Work to condition which existed prior to beginning of Work.

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.

1.2 REFERENCES

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

.2 National Fire Code of Canada (2010).

.3 Comply with National Building Code of Canada 2010, Division B, Part 8, "Safety Measures at Construction and Demolition Sites", and Provincial requirements.

.4 Federal Legislation
.1 Canadian Environmental Assessment Act (CEAA) 1992.
.2 Canadian Environmental Protection Act (CEPA) 1999.
.3 Transportation of Dangerous Goods Act (TDGA) 1992.
.4 Occupational Health and Safety Act.

.5 Annex A - Report to Public Works and Government Services Canada: Designated and Hazardous Materials Survey; Administration Building (WW03) Warkworth Institution. April 2011, 700765-8.

1.3 DEFINITIONS

.1 Deconstruction: the systematic dismantling of a structure to salvage materials for reuse. What cannot be reused is considered subsequently for recycling. The ultimate objective is to recover potentially valuable resources while diverting from landfill what has traditionally been a significant portion of the waste system.

.2 Demolition: rapid destruction of a building with or without prior removal of designated/ hazardous substances. Recyclable materials may be pulled out from the resulting demolition debris.

.3 Salvage: removal of structural and non-structural components from a building during a deconstruction project for the purpose of reuse.

1.3 DEFINITIONS (Cont'd)

.4 Reuse: the use of a building material in its original form and function(i.e. without drastic alteration by melting, shredding, pulverizing, etc.).

.5 Recycling: the use of a building material which has been processed in some way for use in a form and function which is different from its original form and function.

.6 Waste Management Coordinator (WMC): a person or organization appointed to be responsible for supervising all waste management activities as well as coordinating all related, required submittal and reporting requirements.

.7 Designated and Regulated Substances: designated substances are substances that are known for their adverse effect on human health and the environment. These include but are not limited to asbestos, lead, mercury, arsenic, silicate, coke oven emissions, acrylonitrile, benzene, ethylene oxide, isocyanates, and vinyl chloride. Regulated substances include fuels, refrigeration and fire suppression fluids, and PCBs.

.8 Hazardous Materials: dangerous substances, chemicals and goods such as biological contaminants, poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or any other material that, if handled improperly, can endanger human health or well being or the environment.

.9 Alternate Disposal: disposal at other than a landfill or an incineration plant. Alternate disposal includes salvage and delivery for reuse or delivery to an authorized facility for recycling.

.10 Departmental Representative: throughout this section, the term "Departmental Representative" shall refer to the on-site representative of the Project Management body.

1.4 QUALIFICATIONS

.1 Contractor shall be specialized in performing the work of this section with documented experience in similar types of deconstruction projects.

.2 Contractor shall provide a qualified and competent supervisor with previous experience in

1.4 QUALIFICATIONS (Cont'd)

.2 (Cont'd)
deconstruction work who shall be present at all times during the deconstruction activities and who shall direct all work. Designate a person on site who will be responsible for worker and general public safety and who will maintain project site safety procedures and requirements.

.3 Ensure workers and subcontractors employed on the project are trained to carry out work in accordance with the appropriate deconstruction techniques.

1.5 REGULATORY REQUIREMENTS

.1 Conform to applicable codes and regulations for deconstruction of buildings, safety of adjacent structures, noise and dust control, removal of common and hazardous waste and disposal. Refer also to Clause 1.7 of this section.

.2 Complete all deconstruction work according to the requirements of the Canadian Construction Safety Code, Provincial Labour and WSIB Regulations and Waste Management regulations.

.3 Obtain required authorization, certificates and permits from authorities having jurisdiction. Acquire adequate insurance for potential liabilities related to material pickup from the project site, as applicable.

.4 Notify Departmental Representative and affected utility companies before starting work, and comply with their requirements.

.5 Do not close or obstruct safety exits, adjacent sidewalks, hydrants, parking or storage areas without prior approval of Departmental Representative.

.6 Conform to applicable regulatory procedures when discovering hazardous or contaminated materials that were not previously documented.

.7 Only those resale/brokerage, storage, recycling, transfer and/or disposal facilities which comply with the provincial and municipal regulations and by-laws shall be used by the contractor for the disposal of materials generated at the deconstruction project.

1.6 PERFORMANCE REQUIREMENTS

.1 Salvage materials from the structure and segregate unsalvageables for recycling to achieve maximum diversion of waste that otherwise would be destined for landfill disposal.

1.7 SUBMITTALS

.1 Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details showing sequence of deconstruction work and supporting structures and underpinning.

.2 Submit plans stamped and signed by qualified professional engineer registered or licensed in the Province of Ontario, Canada.

.3 Submit a verified list of certified/authorized equipment dismantlers, material haulers, receivers and/or end users of salvaged materials, recycling facilities, and waste disposal facilities proposed for the work.

.4 Submit certified used building material receipts, from authorized disposal sites and reuse and recycling facilities for all material removed from site to Depatmental Representative on a bi-weekly basis. Written authorization from Departmental Representative is required to subsequently deviate from the facilities and receiving organizations, listed in the above submission Clause 1.5.1.

.5 With regards to documentation of materials removal, include but not limited to the five items listed below. This information must be submitted to Departmental Representative in a tabulated format on specific time periods specified by Departmental Representative.
.1 Description of materials.
.2 Time and date of removal.
.3 Weight, volume, or quantity of material.
.4 Breakdown of reuse, recycling and landfill percentages or quantities.
.5 End destination of materials.

.6 Workers, haulers and subcontractors shall possess applicable, current licenses, Certificates of Approval, and/or permits to remove, handle, transport and dispose of materials municipally, and/or federally categorized as designated, hazardous or otherwise regulated substances. Upon written

1.7 SUBMITTALS (Cont'd)

.6 (Cont'd)
request, submit proof of compliance to Departmental Representative within 24 hours.

1.8 QUALITY ASSURANCE

.1 Ensure work is performed in compliance with all applicable federal legislation including CEPA, CEAA, TDGA, MVSA, and all applicable provincial regulations and municipal bylaws.

.2 Document work activities and produce evidence of compliance immediately upon request by Departmental Representative or respective regulatory body.

1.9 SITE CONDITIONS

.1 Contractor shall visit the site at his own expense prior to the submission of bids to ascertain existing site conditions and surrounding features related to the proposed deconstruction, and satisfy himself that conditions are suitable for execution of the work.

.2 Contractor shall accept the site as it exists and will be responsible for all deconstruction work as required.

.3 Prior to start of work, arrange for a site visit together with Departmental Representative, to examine existing exterior and interior site conditions and adjacent structures. Where applicable, the contractor at his expense shall be responsible for taking pictures of any existing damage to adjacent structures and record same in writing to avoid any disputes at a later date.

.4 Where materials or conditions revealed appear to be other than those normally expected or indicated in the Contract documents, the contractor shall immediately inform the Departmental Representative, should such variance of conditions or materials result in a contemplated change to the cost of the work. Should an alternate method of deconstruction or change of materials be appropriate, the Departmental Representative shall immediately give his decision before the work proceeds.
.1 If material resembling spray or trowel applied asbestos or any other designated, or listed as hazardous substance be encountered in course of deconstruction, stop work, take

1.9 SITE CONDITIONS (Cont'd)

.4 (Cont'd)

.1 (Cont'd)
preventative measures, and notify Departmental Representative immediately. Do not proceed until written instructions have been received.

.2 Ensure compliance with the handling, transportation and disposal requirements of fuels, PCBs, halocarbons and other regulated substances that are likely to be encountered during removal, disassembly or dismantling of mechanical and electrical equipment.

.3 Prior to dismantling and removal of equipment specified for salvage, clearly label all parts/components of mechanical to facilitate reassembly, as applicable.

.4 Appropriately label and package all components and parts of mechanical and electrical materials specified for salvage to prevent damage or loss.

.5 Protection:

.1 Prevent movement, settlement or damage of adjacent services, walkways, paving, trees, landscaping, and/or adjacent ground grades. Provide bracing, shoring, and/or underpinning as required. Repair damage caused by deconstruction as directed by Departmental Representative.

.2 Support affected structures and, if safety of structure being deconstructed appears to be endangered, take preventative measures, cease operations and immediately notify Departmental Representative.

.3 Prevent debris from blocking emergency exit routes, surface drainage system, elevators, mechanical and electrical systems which must remain in operation during work.

1.10 SCHEDULING

.1 Ensure project time lines are met without compromising specified minimum rates of material salvage, recovery or diversion. Notify Departmental Representative in writing of any anticipated delays.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Employ equipment and techniques to maximize material salvage potential and segregate all recyclable materials.

.2 Equipment and heavy machinery used during course of demolition shall operate in compliance with EPA CFR 86.098-10, Emission Standards for 1998 and Later Model Year Otto-Cycle Heavy Duty Engines and MVSA.

.3 Leave equipment and machinery running only while in use, except where extreme cold temperatures prohibit shutting down.

.4 Use water misting or water efficient wetting equipment/trucks/attachments for dust suppression.

.5 Demonstrate that all equipment and tools are being used in a manner which allows for the salvage of materials in best condition possible.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Disconnect and re-route electrical, telephone and communication service lines entering buildings to be deconstructed. Post warning signs on electrical lines and equipment which must remain energized to serve other installations during period of deconstruction.

.2 Locate and protect utility lines. Do not disrupt active or energized utilities.

.3 Disconnect and cap designated mechanical services.
.1 Natural gas supply lines: as directed by Departmental Representative.
.2 Sewer and water lines: as directed by Departmental Representative.
.3 Other underground services: remove and dispose of as indicated.

.4 Remove trees and shrubs only when necessary and with Departmental Representative's written approval. Wherever practical, remove trees and shrubs and temporarily store in a manner and condition for re-planting on-site or elsewhere.

3.1 PREPARATION (Cont'd)

.5 Post signs in visible locations and appropriate languages to alert workers, subcontractors, haulers, and public to the job site hazards, travel routes, location of processing and stockpiling of each material, material storage bin location and use, e.g. "CLEAN WOOD ONLY".

3.2 PROTECTION

.1 Do not dispose of waste or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.

.2 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties. Control runoff or disposal of water containing suspended materials or other harmful substances in accordance with local authorities.

.3 Protect trees, plants and foliage on site and adjacent properties where indicated.

.4 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during deconstruction activities.

.5 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust and mud tracking on all temporary roads.

.6 Stop work immediately if adjacent installations or structures appear to be in danger. Notify Departmental Representative. Do not resume work until directed by Departmental Representative.

.7 Provide, install and maintain all necessary and/or legally-required railings, guards and warning signs during execution of the work to fully protect all persons from loss, damage, death or injury.

.8 It is the Contractor's responsibility to ensure that the methods, equipment and/or techniques used during the deconstruction activities do not overload or undermine any structural members or jeopardize the overall safety of the operation.

.9 It is the responsibility of the Contractor to design, provide, install and maintain an adequate temporary shoring and/or bracing that

3.2 PROTECTION (Cont'd)

.9 (Cont'd)
may be required during the deconstruction activities.

.10 Protect existing structures, equipment and machinery which are not to be dismantled or salvaged. Protect from damage all property and site improvements in the immediate surroundings of the project area. Make good all damages to property and improvements including sidewalks, curbs, landscaped or paved areas and other finishes that may be damaged during execution of the deconstruction work.

.11 Prevent debris from blocking surface drainage systems, exits, travel routes, mechanical and electrical systems that are to remain in operation or have been decommissioned during the work.

.12 It is the Contractor's responsibility to design, provide, install and maintain all necessary lighting and temporary fire protection requirements.

3.3 REMOVAL OF DESIGNATED/ HAZARDOUS WASTES

.1 Prior to start of deconstruction work, identify and remove all designated and hazardous substances as defined by authorities having jurisdiction and other materials contaminated by such substances as directed by Depatmental Representative. Handle in a safe manner and transport in accordance with TDGA and provincial/regional regulations/by-laws and dispose of at facilities authorized to receive the respective materials in accordance with the applicable regulatory requirements.

.2 Contractors must be familiar with Annex A, DSHMS for Warkworth Institution Building WW03.

3.4 DISASSEMBLY

.1 Materials removed from structures are property of Owner.

.2 Throughout the course of deconstruction, pay close attention to connections and material assemblies. Employ workmanship procedures which minimize damage to salvageable materials and equipment.

3.4 DISASSEMBLY (Cont'd)

.3 Deconstruct in accordance with CSA S350 and all other applicable safety regulations, codes, guidelines and standards.

.4 Workers must utilize adequate fall protection where necessary.

.5 Maintain structural integrity of structure at all times.

.6 Systematically remove all finishes, furnishings, mechanical and electrical equipment.

.7 Carefully and methodically separate materials into reusable, recycleable and waste streams.

.8 At end of each day's work, leave work in safe and stable condition.

.9 Do not backfill excavations or below grade cavities until inspected by Departmental Representative.

3.5 PROCESSING

.1 Designate location for processing of materials which eliminates unnecessary double handling and provides adequate space to maintain efficient material flow.

.2 De-nail, strip, separate, materials in manner which ensures best possible condition of salvaged materials.

.3 Keep processing area clean, organized and free of debris.

.4 Supply separate, clearly marked disposal bins for all categories of materials. Do not remove waste bins from site until inspected and approved by Departmental Representative. Notify Departmental Representative prior to removal of any material bins from site.

.5 Separate and prepare processed materials into organized piles for proper handling and storage or transportation. Provide collection area for materials designated for alternate disposal.

3.6 STORAGE AND STOCKPILING

.1 Store salvaged materials in designated secure areas and protect from the elements. Clearly label all stockpiles, indicating material type and quantity.

.2 Employ reasonable means necessary to protect salvaged materials from vandalism, theft, adverse weather or inadvertent damage by heavy machinery. Designate a worker, hire security, erect temporary fencing as necessary.

.3 Locate stockpiled materials convenient for use in new construction. Eliminate double-handling wherever possible.

.4 Stockpile materials designated for off-site destinations in locations which facilitate removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

.5 Maximum permitted duration of material storage on site is between commencement and completion dates stipulated in the project contract documents.

3.7 TRANSPORTATION AND DISPOSAL

.1 Load, transport salvaged material and unload at destination so that material is delivered in condition that is acceptable to the end user.

.2 Transport recyclable materials in appropriate containers and in accordance with applicable provincial/territorial and municipal requirements.

.3 Transport solid waste, contaminated materials and/or hazardous materials/waste in in accordance with TDGA and related provincial/territorial and municipal regulations and by-laws. Contaminated materials and waste must be transported by appropriately licensed/authorized haulers.

.4 Salvaged reusable materials, recyclables, waste, and contaminated or hazardous materials removed from the project site shall be transported by and delivered to appropriately licensed or authorized facilities listed in waste reduction workplan. Do not deviate from facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.

3.7 TRANSPORTATION AND DISPOSAL (Cont'd)

.5 Recyclable materials, solid waste, contaminated or hazardous materials removed from the site shall be disposed of at appropriately licensed or authorized facilities only. Contractor shall provide legal evidence of appropriate disposal to the Departmental Representative.

.6 Individuals or organizations receiving salvaged reusable materials must for ever indemnify the owner and the project team against all claims arising from handling, transportation, and use of the materials. The contractor is responsible to obtain such legal indemnification to the Departmental Representative's satisfaction.

3.8 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout deconstruction activities.

.2 Upon completion of project, remove debris, trim surfaces and leave work site clean.

.3 Fires and burning of waste or materials is not permitted on-site.

.4 Do not bury material on-site unless the activity is authorized by the Departmental Representative in writing and the material is processed for use as fill and meets all applicable regulations and codes.

.5 Upon completion of project, reinstate all areas, affected by Work to match condition of adjacent, undisturbed areas.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 O.Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.

.2 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, http://www.labour.gov.on.ca/english/hs/asbestos/index.html.

.3 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.205-94, Sealer for Application of Asbestos Fibre Releasing Materials.

.4 Department of Justice Canada (Jus)
.1 Canadian Environmental Protection Act, 1999 (CEPA).

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

.6 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 Underwriters' Laboratories of Canada (ULC).

1.2 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.2 Asbestos Containing Materials (ACMs): materials that contain provincial regulated amount per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.4 Authorized Visitors: Engineers, or designated representatives, and representatives of regulatory agencies.

.5 Competent worker person: in relation to specific work, means a worker who:
.1 Is qualified because of knowledge, training and experience to perform the work.

1.2 DEFINITIONS (Cont'd)

.5 Competent worker person:(Cont'd)
.2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.
.3 Has knowledge of all potential or actual danger to health or safety in the work.

.6 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

.7 Glove Bag: prefabricated glove bag as follows:
.1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
.2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
.3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
.4 Straps for sealing ends around pipe.

.8 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.10 Occupied Area: any area of building or work site that is outside Asbestos Work Area.

.11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.12 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.

1.3 SUBMITTALS (Cont'd)

.3 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.

.6 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.8 Submit Worker's Compensation Board status and transcription of insurance.

.9 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
.1 Encapsulants;
.2 Amended water;
.3 Slow drying sealer.

.10 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.

1.4 QUALITY ASSURANCE (Cont'd)

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

.2 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes

1.4 QUALITY ASSURANCE (Cont'd)

.2 Health and Safety:(Cont'd)

.2 Safety Requirements:(Cont'd)

.1 (Cont'd)

suitable footwear, and it to be repaired or replaced if torn.

.3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are located as indicated on drawings.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.7 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

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.

1.5 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.4 Separate for reuse and recycling and place in designated containers 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 the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial/Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.6 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project are available from Departmental Representative on request.

.2 Notify Departmental Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

.3 For Building WW03, refer to Designated Substances and Hazardous Materials Survey (DSHMS) prepared by Decommissioning Consulting Services Ltd., April 2011.

.4 For Buildings WW02, WW12, and WW15 refer to Designated Substances and Hazardous Materials Survey (DSHMS) prepared by XCG, March 30, 2003.

.5 DSHMS documents also available on the OPROMA System.

1.7 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, at minimum:
.1 Fitting of equipment.
.2 Inspection and maintenance of equipment.
.3 Disinfecting of equipment.
.4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Drop and Enclosure Sheets:
.1 Polyethylene: 0.15 mm thick.
.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.

.3 Waste Containers: contain waste in two separate containers.
.1 Inner container: 0.15 mm thick sealable polyethylene bag or where glove bag method is used, glove bag itself.
.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.

.4 Glove bag:
.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.

2.1 MATERIALS (Cont'd)

.4 Glove bag:(Cont'd)

.2 The glove bag to be equipped with:

.1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.

.2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure.

.3 A tool pouch with a drain.

.4 A seamless bottom and a means of sealing off the lower portion of the bag.

.5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing.

PART 3 - EXECUTION

3.1 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

.2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING

3.2 PROCEDURES (Cont'd)

.2 (Cont'd)
ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.

.3 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
.1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
.2 Do not use compressed air to clean up or remove dust from any surface.

.4 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
.2 When removing suspended ceilings and walls themselves do not enclose work area and when removing asbestos containing material from piping or equipment and "glove bag" method is not used erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from work area.

.5 Before removing suspended ceilings, remove friable material on upper surfaces using HEPA vacuum equipment.
.1 Remove and clean surfaces of ceiling panels using HEPA vacuum, wrap clean panels in 0.10 mm thick polyethylene, and store in building as directed by Departmental Representative.
.2 Clean "T" grid suspension system, disconnect, wrap in 0.10 mm thick polyethylene, and store in building as directed by Departmental Representative.

.6 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
.1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.
.2 Perform Work in a manner to reduce dust creation to lowest levels practicable.

3.2 PROCEDURES (Cont'd)

.7 Pipe Insulation Removal Using Glove Bag:

.1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure if:

.1 It may not be possible to maintain a proper seal for any reason including, without limitation:

.1 The condition of the insulation.

.2 The temperature of the pipe, duct or similar structure.

.2 The bag could become damaged for any reason including, without limitation.

.1 The type of jacketing.

.2 The temperature of the pipe, duct or similar structure.

.2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.

.3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.

.4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.

.5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.

.6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.

.7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.

3.2 PROCEDURES (Cont'd)

.7 (Cont'd)
.8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

.8 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.9 Cleanup:
.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
.3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
.4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples on daily basis outside of Asbestos Work Area enclosures in accordance with PWGSC requirements.
.1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosures are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.

3.3 AIR MONITORING (Cont'd)

.3 Ensure that respiratory safety factors are not exceeded.

.4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of fibrous aerosol monitors (FAM).

.1 When FAM readings exceed 0.25 f/cc, adopt more stringent Work procedures immediately and perform PCM test.

.2 Stop Work when PCM measurements exceed 0.01 f/cc and correct procedures.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 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 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete hardener and curing compound and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit 2 copies of WHMIS MSDS.

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 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.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 FLOOR HARDENER

.1 Non-metallic hardener: premixed, dry shake surface hardener, cement to hardener ratio 2 to 1, cement colour.

2.2 SLIP RESISTANT ABRASIVE AGGREGATE

.1 Emery aggregate: crushed emery, minimum 50% aluminum oxide.

2.3 COLOURING AGENT

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

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of slab previously installed under other Sections or Contracts are acceptable for concrete hardener and curing compound application 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 HARDENING

.1 Apply floor hardener aggregate in accordance with manufacturer's written instructions.

.2 Apply slip resistant coating on floor surfaces as scheduled.

.3 Apply slip resistant coating in accordance with manufacturer's written instructions.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

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

.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 finished installation until floor treatment has completely cured.

.2 Repair damage to adjacent materials caused by concrete floor hardener installation.

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 A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.3 ASTM A269-10, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
.4 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 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 S16-09, Design of Steel Structures.
.3 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
.4 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding).

.3 Environmental Choice Program
.1 CCD-047-98(R2005), Architectural Surface Coatings.
.2 CCD-048-98(R2006), Surface Coatings - Recycled Water-borne.

.4 Green Seal Environmental Standards (GS)
.1 GS-11-2008, 2nd Edition, Paints and Coatings.

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

.6 The Master Painters Institute (MPI)
.1 Architectural Painting Specification Manual.

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 each items and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two copies of WHMIS MSDS.
.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.

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 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.

.4 Packaging Waste Management: remove for reuse and returnof pallets, crates, padding and packaging materials as specified in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W, minimum 30% recycled content.

.2 Welding materials: to CSA W59.

.3 Welding electrodes: to CSA W48 Series.

.4 Bolts and anchor bolts: to ASTM A307.

.5 Aluminum alloy: extrusions to Aluminum Association

Designation AA6063-T5, sheet to Designation AA1100, minimum 80% recycled content, brushed aluminum with designation AA-A31 clear anodized finish.

.6 Stainless steel tubing: to ASTM A269, Type 304 seamless welded with AISI No. 4 finish, minimum 75% recycled content.

.7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof 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 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2, Coating Grade 85, to ASTM A123/A123M.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:
.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to CCD-047a.

.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, 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 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 Finish: galvanized.

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.

.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 CHANNEL FRAMES

.1 Install steel channel frames to openings as indicated.

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 fabrications installation.

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute / National Particleboard Association (ANSI/NPA)
.1 ANSI/NPA A208.1-2009, Particleboard.

.2 ASTM International
.1 ASTM A123-12/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.
.3 ASTM C578-11be1, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
.4 ASTM C1289-11a, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
.5 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
.6 ASTM D1761-06, Standard Test Methods for Mechanical Fasteners in Wood.
.7 ASTM D5055-11a, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
.8 ASTM D5456-11a, Standard Specification for Evaluation of Structural Composite Lumber Products.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 19-GP-5M(1984), Sealing Compound, One Component, Acrylic Base, Solvent Curing (Incorporating Amendment No. 1).
.2 CAN/CGSB-11.3-M87, Hardboard.
.3 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
.4 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
.5 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.

.4 CSA International
.1 CAN/CSA-A123.2-03(R2008), Asphalt Coated Roofing Sheets.
.2 CAN/CSA-A247-M86(R1996), Insulating Fiberboard.
.3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
.4 CSA O80 Series-08, Wood Preservation, Includes Update No. 1 (2008).
.5 CAN/CSA-O86-09 Consolidation, Engineering Design in Wood.
.6 CSA O112 Series-M1977(R2006), CSA Standards for

Wood Adhesives.
.7 CSA O121-08, Douglas Fir Plywood.
.8 CAN/CSA-O122-06(R2011), Structural Glued-Laminated Timber.
.9 CSA O141-05(R2009), Softwood Lumber.
.10 CSA O151-09, Canadian Softwood Plywood.
.11 CSA O153-M1980(R2008), Poplar Plywood.
.12 CSA O325-07, Construction Sheathing.
.13 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
.14 CAN/CSA-Z809-08, Sustainable Forest Management.

.5 National Lumber Grades Authority (NLGA)
.1 Standard Grading Rules for Canadian Lumber December 1, 2010.

.6 The Truss Plate Institute of Canada
.1 Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses [2007].

.7 Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULC-S706-[09], Standard for Wood Fibre Insulating Boards for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 11 01 and 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 11 01 and 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 in clean, dry, well-ventilated area.
.2 Store and protect wood from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 11 01.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01.

PART 2 - PRODUCTS

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

.1 Lumber: softwood, S4S, moisture content S-DRY graded and stamped in accordance with following standards:
.1 CSA O141.
.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Furring, blocking, nailing strips, strapping, grounds, rough bucks, bracing, bridging, curbs, fascia backing and sleepers: NLGA spruce, pine or fir (SPF), 121c. and pine, 113d.

.3 Plywood, OSB and wood based composite panels: to CSA O325.

2.2 ACCESSORIES

.1 Nails, spikes and staples: to CSA B111.

.2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

.4 Fastener Finishes:
.1 Galvanizing: to ASTM A123/A123M, ASTM A653/A653M, use galvanized fasteners for exterior work, interior highly humid.

PART 3 - EXECUTION

3.1 EXAMINATION

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

.4 Treat material as indicated:
.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

3.3 INSTALLATION

.1 Apply wood preservative to wood in contact with roofing.

.2 Install members true to line, levels and elevations, square and plumb to a tolerance of 1:600 and rigidly secure in place.

.3 Construct continuous members from pieces of longest practical length.

.4 Select exposed framing for appearance. Install materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

.5 Install nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.6 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

.7 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.8 Countersink bolts where necessary to provide clearance for other work.

.9 Secure exterior work with galvanized or non- ferrous fasteners.

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 rough carpentry installation.

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

.1 Have work of this Section designed by a professional engineer based on the environmental conditions required by the building code and the extent of the roof area receiving work of this Section.
.1 Review roof accessories to ensure that the roof watertightness will not be affected by work of this Section.
.2 Co-ordination and ensure compatibility with building structure.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Sections 01 33 00 and 01 78 00.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, and finish.

.3 Shop Drawings:
.1 Bearing professional seal and signature of a professional engineer responsible for the engineering design of work of this Section. Show accessory profile, layout, materials, construction, and securement method to building structure.
.2 Construction details should accurately reflect actual job conditions.

PART 2 - PRODUCTS

2.1 ROOF ACCESSORIES

.1 Round Split Flashing: Non vented cap, 0.46 mm thick type 304 stainless steel, properly sized, EPDM grommet capped seals, continuous EPDM split junction and deck flange seals, coated deck flange compatible with roofing system.

.2 Concrete Pavers: CSA A231.1, precast concrete paving slabs, smooth faced 600 mm x 600 mm x 45 mm thick of steam cured 30 MPa concrete with between 4% and 6% entrained air, with edges chamfered.

.3 Paver Pedestals: High density polyurethane mouldings, adjustable, colour black.

.4 Mechanical AHU Roof Support: Urethane insulated supports 51 mm diameter, milled finish hollow

aluminum, fastened to structural roof deck; aluminium cross-bar carrier with EPDM end caps and anti-vibration pads, 38 mm diameter pipe section cross ties and urethane insulated 0.8 mm Type 304 stainless steel flashing with EPDM Base Seal and coated deck flange compatible with roofing system, height as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Inspect roof system is properly attached and installed to withstand additional retained loading.

3.2 FLASHING INSTALLATION

.1 Comply with manufacturer's installation instructions.

.2 Ensure water-tightness continuity of roofing systems.

.3 Adjust and seal assembly with provision for expansion and contraction of components.

.4 Coat metals contact with dissimilar materials, with isolation coating.

.5 Apply full coverage sealant to fastener penetrations at roof surface and underside of through fasten brackets.

3.3 PAVERS INSTALLATION

.1 Install pavers and pedestals in accordance with manufacturer's written instructions to elevations required. Adjust for final level and slope with shims.

.2 Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

.3 Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

.4 Install pavers to not vary more than 1.6 mm in elevation between adjacent pavers or more than 1.6 mm from surface plane elevation of individual paver.

.5 Maintain tolerances of paving installation within 1:50 of surface plane in any direction.

PART 1 - GENERAL

1.1 ENVIRONMENTAL CHOICE PROGRAM

.1 Provide sealant products bearing the 'Ecologo' of the Environmental Choice Program, Department of the Environment, Canadian Environmental Protection Act, Environmental Choice Product Guidelines ECP/PCE-45-92 for Sealants and Caulking Compounds, except maximum VOC 60 g/L during application and curing.

.2 For primers and sealants, indicate VOC in g/L during application and curing.

1.2 PRODUCT DATA

.1 Submit manufacturer's literature indicating recommended surface preparation, sealant selection and primer for each substrate in accordance with Sections 01 11 01, 01 33 00 and 01 78 00.

PART 2 - PRODUCTS

2.1 SEALANTS

.1 Provide sealant products bearing Environmental Choice Program to CCD-045-95 (R2008) with maximum VOC 60 g/L.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polysulfide Two Part '1B'.
.1 Non-Sag to CAN/CGSB-19.24-M90, Type 2, Class B.

.2 Polysulfide One Part '1C'.
.1 Self-Leveling to CAN/CGSB-19.13-M87, MC-1-40-B-N.

.3 Polysulfide One Part '1D'.
.1 Non-Sag to CAN/CGSB-19.13-M87 MC-2-40-B-N.

.4 Urethanes Two Part '2B'.
.1 Non-Sag to CAN/CGSB-19.24-M90, Type 2, Class B.

.5 Urethanes One Part '2C'.
.1 Self-Leveling to CAN/CGSB-19.13-M87, Type 1.

.6 Urethanes One Part '2D'.
.1 Non-Sag to CAN/CGSB-19.13-M87, Type 2, MCG-2-40.

.7 Silicones One Part '3'.
.1 To ASTM C919-08 and ASTM C920-10, primerless, Type S, Grade NS, Class 50, SWRI validated.

.8 Acrylic Latex One Part '5'.
.1 To CAN/CGSB-19.17-M90.

.9 Acoustical Sealant '6'.
.1 One part silicone to ASTM C919-08 and ASTM C920-08, primerless, Type S, Grade NS, Class 25, SWRI validated.

.10 Preformed compressible and non-compressible back-up materials '10', CFC free.
.1 Polyethylene, urethane, neoprene or vinyl foam. Extruded closed cell foam backer rod. Size: oversize 30 to 50%.
.2 Bond breaker tape. Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Seal interior perimeters of exterior openings as detailed on drawings: Designations 1B, 1D, 2B, 2D, 3.

.2 Joints of underside of precast beams or planks: Designations 1B, 1D, 2B, 2D.

.3 Interior control and expansion joints in floor surfaces: Designations 1C, 2A, 2C, 10.

.4 Perimeters of interior frames, as detailed and itemized: Designations 1B, 1D, 2B, 3.

.5 Joints at tops of non-load bearing masonry walls at the underside of poured concrete: Designations 1B, 1D, 2B, 5, 6.

.6 Exposed interior control joints in drywall: Designations 1B, 1D, 2B, 2D, 5, 6.

2.4 JOINT CLEANER

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

.2 Primer: to manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION OF JOINT SURFACES

.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.

3.2 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.

3.3 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.

3.4 MIXING

.1 Mix materials in accordance with sealant manufacturer's instructions.

3.5 APPLICATION

.1 Ventilate interior spaces during application and curing of sealants to maintain VOCs less than 50 g/l. Coordinate with building manager to ensure existing ventilation system or temporary ventilation supplies sufficient outside air.

.2 Sealant.
.1 Protect installed work of other trades from staining or contamination.
.2 Apply sealant in accordance with manufacturer's application manual and written instructions.
.3 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint. remove tape after sealant applied.
.4 Apply sealant in continuous beads.
.5 Apply sealant using gun with proper size nozzle.

.6 Use sufficient pressure to fill voids and joints solid.
.7 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
.8 Tool exposed surfaces before skinning begins to give slightly concave shape.

.3 Curing.
.1 Cure sealants in accordance with sealant manufacturer's instructions.
.2 Do not cover up sealants until proper curing has taken place.

.4 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.

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
.1 ASTM E1264-08e1, Standard Classification for Acoustical Ceiling Products.
.2 ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-51.34-[M86], Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
.2 CAN/CGSB-92.1-[M89], Sound Absorptive Prefabricated Acoustical Units.

.3 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials.

1.2 SAMPLES

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

.2 Submit duplicate full size samples of each type acoustical units.

1.3 REGULATORY REQUIREMENTS

.1 Fire-resistance rated roof/ceiling assembly: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1. QUALITY ASSURANCE

.1 Minimum speech privacy category SPC tested to ASTM E2638.
.1 Standard Speech Privacy 60-65.
.2 Enhanced Speech Privacy 65-70.
.3 Standard Speech Security 70-75.
.4 Enhanced Speech Security 75-80.
.5 High Speech Security 80-85.
.6 Top Speech Security >85.

1.6 MOCK-UP

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

.2 Construct mock-up 10 m^2 minimum of each type acoustical tile ceiling including one inside corner and one outside corner.

.3 Construct mock-up where directed.

.4 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with ceiling work.

.5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

1.7 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.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before commencement of installation.

.2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

1.9 EXTRA MATERIALS

.1 Provide extra materials of acoustic units in accordance with Section 01 78 00.

.2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.

.3 Extra materials to be from same production run as installed materials.

.4 Clearly identify each type of acoustic unit, including colour and texture.

.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 Intermediate duty system to ASTM C635/C635M-07.

.2 Acoustic units (ACU): mineral fibre 610 x 1219 x 16

mm thick, flat, square edge, white colour, fissured pattern, maximum flame spread rating 25 to CAN/ULC-S102-10, STC minimum 35, butt edge detail.

.3 Exposed tee bar grid components for ACU: cold rolled steel, zinc coated, shop painted, satin sheen, white, interlocking, main and cross tee of double web with rectangular bulb, depth governed by span, 25 mm exposed face.

.4 Hangers: 3.6 mm galvanized soft annealed steel wire.

.5 Accessories: splices, clips, wire ties, retainers and wall moulding, to complement suspension system components, as recommended by system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.

3.2 PREPRATION

.1 Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling.

.2 Avoid using border panels of less than half panel width, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

.1 Install in accordance with ASTM C636-08 except where specified otherwise.

.2 Co-ordinate suspension system with related components.

.3 Install acoustic units parallel to building lines with edge unit not less than 50% of unit width.

.4 Cut acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

.5 Support suspension system main runners at 1200 mm oc maximum with hangers from structure. Assembly shall support super- imposed loads. Maximum permissible deflection, 1/360th of span to ASTM C635/C635M-07 deflection test.

.6 Attach cross member to main runner to provide rigid assembly.

.7 Install suspension assembly to manufacturer's written instructions.

.8 Install flush edge moulding at junction of acoustic unit ceiling and other materials around entire length of joint.

PART 1 - GENERAL

1.1 WORKMANSHIP

.1 Work in this section is to be carried out in strict accordance with manufacturer's instructions by a skilled applicator certified by the manufacturer in the use of this system.

1.2 SUBMITTALS

.1 Submit manufacturer's invoice for materials purchased for this job when requested by the Departmental Representative, in accordance with Sections 01 33 00 and 01 78 00.

.2 Submit proof of slip resistance to ASTM D2047.

1.3 SAMPLES

.1 Submit samples in accordance with Sections 01 33 00 and 01 78 00.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Materials must be applied and allowed to cure at temperatures above 5°C.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Two component, 100% solids, liquid applied polyurethane with sharp sand broadcast in top coat, colour selected by Departmental Representative from manufacturer's Standard range.

PART 3 - EXECUTION

3.1 PREPARATION OF METAL SURFACES

.1 Preparation of metal surfaces to be coated:

.1 Clean surfaces by removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following:

.1 Solvent cleaning: SSPC-SP-1.

.2 Hand tool cleaning: SSPC-SP-2.

.3 Power tool cleaning: SSPC-SP-3.

.2 Scrape edges of old paint back to sound material

where remaining paint is thick and sound, feather exposed edges.

.2 Do not apply coating until prepared surfaces have been accepted by Departmental Representative.

3.2 DEGREE OF CLEANLINESS OF SURFACES

.1 Prior to commencing coating application the degree of cleanliness of surfaces to be in accordance with CGSB 31-GP-404a, including SSPC-Vis 1.

3.3 PROTECTION OF SURFACES

.1 Protect surfaces not to be painted and if damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Apply primer, or pretreatment as soon as possible after surface has been cleaned and before deterioration of surface occurs.

.3 Clean surfaces again if rusting occurs after completion of surface preparation.

.4 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 of coating. Remove contaminants from surface and apply coating immediately.

3.4 APPLYING COATING

.1 Apply coating by trowel or squeegee or combination of both in accordance with manufacturer's recommendations at the rate of 18.5 m^2/4 gallon unit to achieve a minimum thickness of 1.5 mm for the aggregated membrane and 1.0 mm for the unaggregated membrane. Apply 30 mesh silica onto the uncured membrane immediately after membrane application.

.2 Provide cover when covering must be applied in damp or cold weather. Protect, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions required for curing. Protect until coating is dry or until weather conditions are suitable.

.3 Remove coating from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and recoat.

.4 Apply each coat as a continuous film of uniform thickness.

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM F 1859, Standard Specification for Rubber Sheet Floor Covering without Backing.

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
.1 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, feature strips, edge stripe.

.4 Closeout Submittals:
.1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

1.4 AMBIENT CONDITIONS

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

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
.2 Provide 2% of each colour, pattern and type flooring material required for project for maintenance

use.
.3 Extra materials one piece and from same production run as installed materials.
.4 Identify each roll of sheet flooring 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 Rubber Sheet Flooring: Harmoni by Mondo.
.1 Thickness: 3 mm.
.2 Colour 1: H69 Medium Grey.
.3 Colour 2: H75 Pearl Grey.

.2 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
.1 Type: rubber.
.2 Style: cove.
.3 Thickness: 3.17 mm.
.4 Height: 152.4 mm.
.5 Lengths: cut lengths minimum 2400 mm.
.6 Colour: selected by Departmental Representative.

.3 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
.1 Rubber floor adhesives:
.1 Adhesive: maximum VOC limit 60 g/L to SCAQMD Rule 1168.
.2 Cove base adhesives:
.1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.4 Sub-floor filler and leveller: type recommended by flooring manufacturer for use with their product.

.5 Metal edge strips:
.1 Aluminum extruded, with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.6 External corner protectors: as recommended by flooring manufacturer.

.7 Edging to floor penetrations: aluminum, type recommended by flooring manufacturer.

.8 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.
.1 Sealer: maximum VOC limit 100 g/L to SCAQMD Rule 1113.

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 SITE VERIFICATION OF CONDITIONS

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

3.3 PREPARATION

.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.

.4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.5 Prime concrete slab to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

.1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 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. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.3 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.

.4 Run sheets in direction of traffic. Double cut sheet joints heat weld according to manufacturer's printed instructions.

.5 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.

.6 Cut flooring around fixed objects.

.7 Install flooring in pan type floor access covers. Maintain floor pattern.

.8 Continue flooring over areas which will be under built-in furniture.

.9 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.10 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.11 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 APPLICATION: BASE

.1 Lay out base to keep number of joints at minimum.

.2 Clean substrate and prime with one coat of adhesive.

.3 Apply adhesive to back of base.

.4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions. Use 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.

.8 Use toeless type base where floor finish will be carpet, coved type elsewhere.

.9 Install toeless type base before installation of carpet on floors.

.10 Heat weld base in accordance with manufacturer's printed instructions.

3.7 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.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.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 printed instructions.

3.9 PROTECTION

.1 Protect new floors from time of final set of adhesive final inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type.

.2 Maintenance Seminars: Engage a factory authorized service representative to train Owner's maintenance personnel on proper maintenance procedures.

.3 Pre-Installation Meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Departmental Representative of the date and time of the meeting

.4 Manufacturer’s Site Inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.5 Testing of Concrete Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and Product performance. Locate test sites evenly to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.
.1 Cohesive Strength: Minimum 1.45 MPa by tensile load as tested to CSA A23.2-6B. Do one test for every 9 sq.m. or fraction thereof.
.2 Moisture Vapour Emission: Maximum moisture content of 1.36 kg/93 sq.m. per 24 hour as tested to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 93 sq.m., add one test site for each additional 93 sq.m. or fraction thereof..3 Surface Temperature: Minimum 3 degree C above the measured dew point.

1.3 SUBMITTALS

.1 Product Data: Submit manufacturer's technical data, installation instructions and general recommendations for each type of flooring material required.

.2 Samples: Submit 300 mm x 300 mm sample of flooring for approval. Submit additional samples until approval is obtained. Make changes in aggregate mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, colour, gloss, texture and aggregate mix proportion.

.3 Maintenance Data: Provide specific instructions for maintenance, preservation and cleaning. Provide adequate warning of maintenance materials or practices which may be detrimental to flooring.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original, unopened containers with manufacturers labels and seals intact.

.2 Handle and store materials in accordance with manufacturer's printed directions.

.3 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.

.4 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Maintain minimum air and surface temperatures at 16 deg C for 24 hours before, during, and for 48 hours following application, or until cured.

.2 Maintain well-lit and well-ventilated area.

.3 Comply with flooring manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

1.7 MAINTENANCE

.1 Protect adjacent surfaces from damage resulting from work of this Section. If necessary, cover or mask adjacent surfaces to those receiving flooring including fixtures and equipment.

.2 Replace materials soiled during application, and from which soil cannot be completely removed, at no extra cost.

.3 Ensure that spark-proof electrical equipment is used in areas where inflammable materials are being applied.

Prevent use of open flames or equipment that may cause sparks.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Epoxy Floor Coating: Low VOC, low odour; coating and sealer; slip-resistant finish; standard colour.

.2 Primer: As recommended by manufacturer supplying flooring material for types of surface to be primed.

.3 Subfloor Filler: Compatible to floor coating and as recommended by coating manufacturer.

.4 Joint Backing: Preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl, oversized 25%, compatible with sealant, primer, epoxy surfacing and substrate.

.5 Joint Sealant: CAN/CGSB-19.24-M, Type 1, Class B, multi component modified urethane base chemical curing; material compatible with floor finish and as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean subfloor free of laitance, oil, grease, curing and sealing compounds, hardeners, chemical additives and other foreign matter detrimental to flooring application.

.2 Prepare concrete floors with shot blasting or other method recommended by manufacturer. Remove weak concrete, uneven joints, rough areas, foreign and projection off surfaces. Surface to be hard, and sound. Equip dry blasting machine with vacuum to minimize dust.

.3 Repair cracks, holes or other defects in accordance with manufacturer's recommendations. Level subfloor with filler.

.4 Blow clean control joints, sawcuts and cracks with compressed air and grout with material compatible with floor coating materials.

.5 Ensure that masonry backing surfaces for cove bases are free of voids and irregularities. Fill recessed

joints with recommended epoxy plaster.

3.2 INSTALLATION

.1 Mix and apply work in strict accordance manufacturer's printed directions in specified thickness, with integral cove bases, uninterrupted except at sawn joints or other types of joints required, free of laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

.2 Work coating into corners and other restricted areas, up and over bases, and into recesses in floors to ensure full coverage.

.3 Make clean true junctions with no visible overlap between adjoining applications of coatings.

.4 Primer: Apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application co-ordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

.5 Finish coats: Apply minimum of two finish coats at spreading rate recommended by manufacturer to achieve minimum total thickness of 0.5 mm DFT. Allow minimum recommended drying time between coats.
.1 Base Coat: Apply base coat and immediately broadcast aggregates and back roll to obtain slip-resistant texture finish. Let dry.
.2 Top Coat: Apply top coat to dry base coat for consistent appearance.

.6 Cove Base: Provide 150 mm high cove base struck straight to provide line for wall finish.

3.3 ADJUSTMENT AND CLEANING

.1 Touch up and refinish minor defects in work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

.2 Remove promptly as work progresses spilled or splattered coating materials from adjacent surfaces. Clean floors on completion of Work. Do not mar surfaces while removing splatters.

.3 Protect completed work from traffic for at least one week to allow proper curing of floor finish. Protect work from any trades using area after completion of installation.

PART 1 - GENERAL

1.1 REFERENCES

.1 Architectural Painting Specifications Manual, Master Painters Institute (MPI), 2010.

.2 Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).

.3 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

.4 National Fire Code of Canada 2010 (NFC).

1.2 QUALITY ASSURANCE

.1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

.5 Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

.6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

.7 Standard of Acceptance:

.1 Ceilings: No defects visible from floor at 45° to surface when viewed using final lighting source.
.2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.3 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

.1 Provide paint products meeting MPI "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels.

.2 Where indoor air quality (odour) is a problem, use only MPI listed materials having a minimum E2 rating.

1.4 INSPECTION REQUIREMENTS

.1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Departmental Representative and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

.3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.

1.5 SCHEDULING OF WORK

.1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Consultant for any changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.6 SUBMITTALS

.1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 11 01.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 11 01.

.3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
.1 Product name, type and use.
.2 Manufacturer's product number.
.3 Colour numbers.
.4 MPI Environmentally Friendly classification system rating.
.5 Manufacturer's Material Safety Data Sheets (MSDS).

1.7 SAMPLES

.1 Submit full range colour sample chips in accordance with Section 01 11 01. Indicate where colour availability is restricted.

.2 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 submitted on the following substrate materials:
.1 3 mm plate steel for finishes over metal surfaces.
.2 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 When approved, sample panels shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

1.8 QUALITY CONTROL

.1 Provide mock-up in accordance with Section 01 45 00.

.2 When requested by Departmental Representative [Paint Inspection Agency], prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.

1.9 EXTRA MATERIALS

.1 Submit maintenance materials in accordance with Section 01 78 00.

.2 Submit one - one litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Deliver to Contractor and store where directed.

1.10 DELIVERY, HANDLING AND STORAGE

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Labels shall clearly indicate:
.1 Manufacturer's name and address.
.2 Type of paint or coating.
.3 Compliance with applicable standard.
.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Departmental Representative.

.10 Remove paint materials from storage only in quantities required for same day use.

.11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:
.1 Provide one fire extinguisher adjacent to storage area.
.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
.3 Handle, store, use and dispose of flammable and

combustible materials in accordance with the National Fire Code of Canada.

1.11 SITE REQUIREMENTS

.1 Heating, Ventilation and Lighting:

.1 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.

.2 Where required, provide continuous ventilation for seven days after completion of application of paint.

.3 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.

.4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.5 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by the specifying body, Paint Inspection Agency and the applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10°C.

.2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is above 85% or when the dew point is less than 3°C variance between the air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.2 Perform no painting work when the maximum moisture content of the substrate exceeds:

.1 12% for plaster and gypsum board.

.3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.4 Test concrete, masonry and plaster surfaces for

alkalinity as required.

.3 Surface and Environmental Conditions:
.1 Apply paint finish only 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 only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
.3 Apply paint only when previous coat of paint is dry or adequately cured.

.4 Additional Interior Application Requirements:
.1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.12 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.,) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground the following procedures shall be strictly adhered to:
.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
.4 Dispose of contaminants in an approved legal

manner in accordance with hazardous waste regulations.
.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, or organizations for verifiable re-use or re-manufacturing.

.8 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems shall be products of a single manufacturer.

.3 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project.

.4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
.1 be water-based.
.2 be non-flammable.
.3 be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
.4 be manufactured without compounds which contribute to smog in the lower atmosphere.

.5 Water-borne surface coatings must be manufactured and transported in a manner that steps of process, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

.6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.7 Water-borne surface coatings and recycled water-borne

surface coatings must have a flash point of 61.0°C or greater.

.8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
.1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

2.2 COLOURS

.1 Submit proposed Colour Schedule to Departmental Representative for approval.

.2 No more than eight colours will be selected for the entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturers full range of colours.

.4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

.5 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representative's written permission.

.2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.

.3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.

.4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions

are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	Units @ 60°	Units @ 85°
G1 – matte finish	0 to 5	max. 10
G2 – velvet finish	0 to 10	10 to 35
G3 – eggshell finish	10 to 25	10 to 35
G4 – satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 INTERIOR PAINTING SYSTEMS

.1 Concrete Masonry Units: smooth and split face block and brick
- .1 INT 4.2A (new work) – latex semi gloss finish.
- .2 RIN 4.2A (re-painting) – latex semi gloss finish.

.2 Structural Steel and Metal Fabrications: columns, beams, joists, etc.
- .1 INT 5.1J Pigmented polyurethane finish (over epoxy and epoxy zinc rich primer).

.2 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock type material", etc., and textured finishes
- .1 INT 9.2A(new) - Latex semi gloss level finish (over latex sealer).
- .2 RIN 9.2A (re-painting) – latex semi gloss finish.

PART 3 - EXECUTION

3.1 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.2 EXISTING CONDITIONS

.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 a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Departmental Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:
.1 Stucco, Plaster and Gypsum Board: 12%.

3.3 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about the building.

.5 Removal of electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings shall be done prior to undertaking any painting operations by General Contractor. Items shall be securely stored and re-installed after painting is completed by General Contractor.

.6 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Departmental Representative.

3.4 CLEANING AND PREPARATION

.1 Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths.

.2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.

.2 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.

.3 Where possible, prime 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.

.4 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.

.5 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes or vacuum cleaning.

.7 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated

material.

.8 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by roller. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:
.1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
.2 Work paint into cracks, crevices and corners.
.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Departmental Representative.
.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:
.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
.4 Brush out immediately all runs and sags.
.5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Departmental Representative.

.5 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

3.6 FIELD QUALITY CONTROL

.1 Field inspection of painting operations to be carried out be independent inspection firm as designated by Departmental Representative.

.2 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.3 Co-operate with inspection firm and provide access to areas of work.

3.7 RESTORATION

.1 Clean and re-install all hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

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).

.2 Canadian Standards Association (CSA International).
.1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
.2 CAN/CSA-B125.3-05, 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 and return by manufacturer of pallets crates paddling and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

.1 Above ground condensate drain and pipe Type DWV to: ASTM B306.
  .1 Fittings.
    .1 Wrought copper: to CAN/CSA-B125.3.
  .2 Solder: tin-lead, 50:50, type 50A, to ASTM B 32.

2.2 FUNNEL FLOOR DRAIN

.1 Coated cast iron body vandalproof drains, complete with a 12 mm (1/2") diameter trap primer connection, with a ductile iron stariner and a polished nickel bronze oval funnel.

2.3 CLEANOUTS

.1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.

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 Piping : in accordance with Section 23 05 05.

.2 Insulation: in acordance with Section 23 07 15

.3 Cleanouts: install as indicated on drawings and as necessary in accessible location allowing for removal of plug and proper servicing.

.4 Floor drain:
  .1 Equip each drain with a trap.
  .2 Exactly locate floor drains to suit the location of drain pipes. Confirm the exact location of drains prior to roughing in.
  .3 Temporarily plug floor drains during construction procedures. Remove plugs during final cleanup work and demonstrate free and clear operation of drain. Replace any damaged grates.

3.3 TESTING

.1 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:
.1 Ensure accessible and that access doors are correctly located.
.2 Open, cover with linseed oil and re-seal.
.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Affix applicable label (storm, sanitary, vent, pump discharge etc.)in accordance with section 23 05 53.01

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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 09 91 23 - Interior Painting.

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

1.2 EQUIPMENT LIST

.1 Complete list of equipment and materials to be used on this project by adding manufacturer's name, model number and details of materials, and submit for approval.

.2 Submit for approval within 10 days after award of contract.

1.3 TRIAL USAGE

.1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.4 PROTECTION OF OPENINGS

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

1.5 PAINTING

.1 To Section 09 91 23.

.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.

1.6 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.

1.7 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.

1.8 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.

1.9 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.

1.9 CLOSEOUT SUBMITTALS (Cont'd)

.3 Operation data to include:(Cont'd)
.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.

1.10 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.

1.10 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.3 (Cont'd)
.3 Points of operation on performance curves.
.4 Manufacturer to certify as to current model production.
.5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 101 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.11 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork.

1.12 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.

1.13 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.

1.14 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

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 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Sections 01 11 00 and 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 of pallets, crates, 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.

3.2 CONNECTIONS TO EQUIPMENT (Cont'd)

.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 Install drain piping to approved location and terminate where discharge is visible or accessible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

3.6 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

3.6 PIPEWORK INSTALLATION (Cont'd)

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated, including coordination with electrical conduits using same support systems.

.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 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.

.15 Check Valves:
.1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 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. Plant to have low VOC content.

.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.

3.8 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.

3.9 PREPARATION FOR FIRE STOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 01 73 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.

3.10 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 relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 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.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK (Cont'd)

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.12 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative. Existing systems are to be kept live and active up until final tie in period to limit necessity for flushing existing piping system.

.2 Request written approval 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work. Provide strainer protection for new plant system to eliminate possible carryover of contaminants from existing system.

.4 Ensure daily clean-up of existing areas.

3.13 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 Sections 01 74 20.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE 90.1-2007, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC).

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 78 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 two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.
.2 Shop Drawings: submit drawings in conjunction with equipment submissions from manufacturers.
.3 Quality Control: in accordance with Section 01 45 00.
.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.
.1 Departmental Representative will make available 4 copies of systems supplier's installation instructions.
.4 Closeout Submittals
.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in S.Section 01 78 00.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 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 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 local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 Motors under 373 W, 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.4 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 ° C, 3 phase, 575 V, unless otherwise specified or indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 DRIVE GUARDS

.1 Guard for flexible coupling:
.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
.2 Securely fasten in place.
.3 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.

3.2 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.
.1 Start up and commissioning.

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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 23 05 53.01 - Mechanical Identification.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100-05, 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.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:
- .1 Thermometers.
- .2 Pressure gauges.
- .3 Stop cocks.
- .4 Syphons.
- .5 Wells.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

.2 Collect, separate and place in designated containers for reuse and recycling paper, plastic, polystyrene, corrugated cardboard, packaging material in accordance with Waste Management Plan.

1.5 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.3 Fold up metal banding, flatten and place in designated area for recycling.

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 200 mm scale length: to ASME B40.200.
.1 Black aluminum casing.

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter mercury-free liquid filled activated dial type: to ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

.2 Remote reading thermometers to be used when piping is too high to see the thermometers clearly. Max height is set at 2100 AFF to centre line of pipe at which remote reading unit is required.

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.
.1 Provide:
.1 Snubber for pulsating operation.
.2 Diaphragm assembly for corrosive service.
.3 Gasketted pressure relief back with solid front.

2.5 PRESSURE GAUGES (Cont'd)

.1 (Cont'd)
.4 Bronze stop cock.
.5 Oil filled for high vibration applications.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:
.1 Pumps.
.2 Coils.

.3 Install wells for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:
.1 Suction and discharge of pumps.
.2 Inlet and outlet of coils.
.3 In other locations as indicated.

.2 Install S.S. Dahl ball valves as gauge cocks for balancing purposes, elsewhere as indicated or direct by commissioning agent.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01, identifying medium.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B31.1-07, Power Piping.

.2 ASTM International
.1 ASTM A125-1996(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 drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.2 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.5 Manufacturers' Instructions:
.1 Provide manufacturer's installation instructions.
.1 Departmental Representative will make available 1 copy of systems supplier'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 20.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:
.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

.2 Performance Requirements:
.1 Design supports, platforms, catwalks, hangers to withstand seismic events as specified Section 23 05 48.

2.2 GENERAL

.1 Refer to Mechanical drawings for details of hangers and supports for piping and equipment.

.2 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ANSI B31.1.

.3 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.4 Acceptable hanger and support manufacturers are Anvil, hunt Manufacturing, Myatt and Apex.

2.3 PIPE HANGERS

.1 Finishes:
.1 Pipe hangers and supports: galvanized after manufacture.
.2 Use electro-plating galvanizing process.
.3 Ensure steel hangers in contact with copper piping are copper plated .

.2 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, FM approved to MSS SP 69.
.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut FM approved.

.3 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 FM approved to MSS SP 69.

.4 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.

.5 Pipe attachments: material to MSS SP 58:
.1 Attachments for steel piping: carbon steel black galvanized.
.2 Attachments for copper piping: copper plated black steel.

2.3 PIPE HANGERS (Cont'd)

.5 Pipe attachments:(Cont'd)
.3 Use insulation shields for hot pipework.
.4 Oversize pipe hangers and supports.

.6 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: black.

2.4 RISER CLAMPS

.1 Steel: galvanized carbon steel to MSS SP 58, type 42.

.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 hot piping:
.1 Galvanized steel shield between the insulation and the hanger.The shield shall cover 1/4 of the pipe's circumference as a minimum. The length and thickness shall be as follows:
.2 150 mm long and 2mm thick (14 gauge) for pipes up to 50mm. Between shield and pipe, install a section of high density insulation complete with a continous vapor barrier.

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.

2.6 CONSTANT SUPPORT SPRING HANGERS (Cont'd)

.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.

.5 Steam support hangers to be used on steam and condensate lines.

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.

.2 Concrete pads as indicated on drawings.

2.11 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel.

.2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

.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, 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 Ontario Building Code and authority having jurisdiction.

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 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.

.4 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	

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.

3.7 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

PART 1 - GENERAL

1.1 REFERENCES

.1 National Building Code of Canada (NBC) 2005.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.3 Provide detailed drawings of all seismic control measures for equipment and piping.

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 GENERAL

.1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 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.

2.3 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

2.3 SPRINGS (Cont'd)

.1 (Cont'd)
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 and for 100% relative humidity installations.

.4 Colour code springs.

2.4 SPRING MOUNT

.1 Type M1 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.

2.5 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.

2.5 HANGERS (Cont'd)

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.6 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.

2.7 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.

2.8 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

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.
.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.

3.3 TESTING (Cont'd)

.2 Vibration measurements shall be taken for equipment as indicated. listed below:.
- .1 Hot water Pumps.
- .2 Energy Recovery Ventilator.
- .3 Variable Refrigerant Volume Outdoor Unit.

.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)with the NC levels in the offices not exceeding:
- .1 NC 35 in Offices.
- .2 NC 32 in Meeting Rooms and Boardrooms.

.5 Submit complete report of test results including sound curves.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
.1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.2 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.2 Product data to include paint colour chips, other products specified in this section.

.3 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 29.06.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with Section 01 61 00.
.2 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 pain and coating material at official hazardous material collections site approved by Departmental Representative.

1.4 DELIVERY, STORAGE, AND HANDLING (Cont'd)

.3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:
.1 Equipment: manufacturer's name, model, size, serial number, capacity.
.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:
.1 Hazardous: red letters, white background.
.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:
.1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
.1 Conform to following table:

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 Identification for PWGSC Preventive Maintenance Support System (PMSS):
.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

2.2 SYSTEM NAMEPLATES (Cont'd)

.4 (Cont'd)
.2 Equipment in Mechanical Room:
.1 Main identifier: size #9.
.2 Source and Destination identifiers: size #6.
.3 Terminal cabinets, control panels: size #5.
.3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work in Bldg WW-02.

.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 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.

2.4 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive plastic-coated cloth 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:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents Marking	Background colour	Legend
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Domestic cold water supply	Green	DOM. CWS
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Condensate Drain	Green	COND. DRAIN

2.5 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.

2.6 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.

2.7 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

.1 Identification in English and French.

.2 Use one nameplate and label for both languages.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting specified Section 09 91 23.01 has been completed and prior to final commissioning and tie-in of new CHP.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC 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.

3.6 VALVES, CONTROLLERS (Cont'd)

.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

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 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 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:
.1 Proper thermal overload protection in place for electrical equipment.

1.9 START OF TAB (Cont'd)

.7 (Cont'd)

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.2 HVAC systems: plus 5%, 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:
.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

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:
.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 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 Project record drawings.
.2 System schematics.

.3 Submit 6 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 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.

1.17 SETTINGS (Cont'd)

.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 this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.2 Do TAB of systems, equipment, components, controls specified Division 23.

.3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.

.4 Quality assurance: Perform TAB under direction of supervisor qualified by standards of AABC or NEBB.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: To include as appropriate:
.1 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.7 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.

.2 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

1.20 HYDRONIC SYSTEMS (Cont'd)

.3 Do TAB of systems, equipment, components, controls specified in Divisions 23 and 25.

.4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.

.5 Quality assurance: perform TAB under direction of supervisor qualified by 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:
.1 Inlet and outlet of boilers,coil, humidifier,pump,control valve, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.8 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.

.9 Perform TAB work on each boiler separately and at 25%, 50%, 75% and 100% capacity operating conditions.

1.21 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.

1.22 POST-OCCUPANCY TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of following areas:
.1 Building 3 - Adminstration building.
.2 Building 2 - Security Post.

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months

1.22 POST-OCCUPANCY TAB (Cont'd)

.2 (Cont'd)
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

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 REFERENCES

.1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.4 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.

1.5 TESTING AGENCY

.1 Installing Contractor.

1.6 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.

1.7 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 three months before anticipated start date.

.5 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

.6 Instruments to be re-calibrated every six months thereafter.

1.8 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 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.

1.9 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating Leakage: 9%.

.2 Leakage rates higher than the tolerance amount will require the contractor to reseal joints in the duct system until leakage rate is brought below tolerance level. Job agency to inform Departmental Representative of this requirement.

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 24 hours of completion of tests. Include:
.1 Schematic of entire system.
.2 Schematic of section under test showing test site.
.3 Required and achieved static pressures.
.4 Orifice differential pressure at test sites.
.5 Permissible and actual leakage flow rate (L/s) for test sites.
.6 Witnessed certification of results.

.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

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, Refrigerating 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 C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .3 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic- Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .5 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .6 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 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.1 REFERENCES (Cont'd)

.2 Reference Standards:(Cont'd)
.5 (Cont'd)
.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 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.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:
.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards or 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, paddling and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied reinforced aluminum foil and kraft paper facing vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

2.3 JACKETS

.1 Canvas:
.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: compatible with insulation.
.3 Aluminum:
.1 To ASTM B209M-10 with and without moisture barrier as scheduled in PART 3 of this section.
.2 Thickness: 0.50 mm sheet.
.3 Finish: Smooth Stucco embossed Corrugated.
.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.
.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
.4 ULC Listed Canvas Jacket:
.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.
.6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
.7 Contact adhesive: quick-setting.
.8 Canvas adhesive: washable.
.9 Tie wire: 1.5 mm stainless steel.
.10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face both faces of insulation one face of insulation with expanded metal lath on other face.
.12 Fasteners: 2 mm diameter pins with35 mm square 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 33 00.
.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.

.7 Insulate :
.1 All outdoor air and exhaust air ducts of the Heat Recovery Unit of building 3 - Adminstration Building
.2 Supply air ducts in Mechanical Room of building 12 - Hobby Craft Building
.3 Supply air ducts in Mechanical Room of building 15 - SIS building

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular Warm Supply Air Ducts	C-1	yes	25
Supply, return and exhaust ducts exposed in space being served			none
Outside Air Ducts to Energy Recovery Ventilator	C-1	yes	50
Exhaust Duct to Energy Recovery Ventilator	C-1	yes	25

3.4 DUCTWORK INSULATION SCHEDULE (Cont'd)

.2 Finishes: conform to following table:

	TIAC Code: Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

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

PART 1 - GENERAL

1.1 SUMMARY

.1 Related Sections:
.1 23 05 05 Installation of Pipework.
.2 23 21 13.01 Hydronic Systems: Copper.
.3 23 21 13.02 Hydronic Systems: Steel.
.4 22 13 17 Drain Piping and Accessories.
.5 23 23 00 Copper Tubing and Fittings Refrigerant.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.1 ASHRAE Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI approved; IESNA co-sponsored.

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM B209-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
.2 ASTM C335/C335M-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C411-05, 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 C533-11, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
.6 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation..
.7 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
.8 ASTM C518-10, Standard Test Method for Steady State Heat Thermal Transmission by Means of The Heat Flowmeter Apparatus.
.9 ASTM C177-10, Standard Test method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of The Guarded-Hot-Plate Apparatus.

.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.

1.2 REFERENCES (Cont'd)

.3 (Cont'd)
.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, Standard for Mineral Fibre Thermal Insulation for Buildings
.4 CAN/ULC-S702.2-10, Standard for Mineral Fibre Thermal Insulation for Buildings Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:
.1 CRF: Code Rectangular Finish.
.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

1.4 SUBMITTALS (Cont'd)

.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 two copies 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.
.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.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.
.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

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

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:
.1 Protect from weather, construction traffic.
.2 Protect against damage.
.3 Store at temperatures and conditions required by manufacturer.

.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.
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M-10.

.3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.

2.2 INSULATION (Cont'd)

.3 TIAC Code A-3:(Cont'd)
.3 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 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: 0.039 W/m Cwhen tested as per ASTM C177 or ASTM C518 at a mean temp of 24 C.
.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.6 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
.1 Insulation: to ASTM C533.
.2 Maximum "k" factor: 0.079 W/m C.
.3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:
.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449-07.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 ABS Plastic:
- .1 One-piece moulded type with pre-formed shapes as required.
- .2 Colours: by Departmental Representative.
- .3 Minimum service temperatures: -40 degrees C.
- .4 Maximum service temperature: 82 degrees C.
- .5 Moisture vapour transmission: 0.012 perm.
- .6 Thickness: 0.75 mm.
- .7 Fastenings:
  - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Locations:
  - .1 For outdoor use ONLY.

.2 Aluminum:
- .1 To ASTM B209-10.
- .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.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 72 69.

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 expansion joints, valves, and flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:
.1 Insulation, fastenings and finishes: same as system.
.2 Jacket: aluminum.

3.5 INSTALLATION OF INSULATION ELASTOMERIC

.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-3 .
.1 Securements: SS wire bands Tape at 300 mm on centre.
.2 Seals: VR lap seal adhesive, VR lagging adhesive.
.3 Installation: TIAC Code: 1501-H.

.3 TIAC Code: A-6.
.1 Insulation securements:.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: C-2 with vapour retarder jacket.
.1 Insulation securements:.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code: 1501-H.

.5 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	Temp deg C	TIAC	Pipe sizes (NPS) and insulation thickness (mm)				
			Runout to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Hot Water Heating	60-94	A-3 C-2	25	38	38	38	38
Refrigerant hot gas & liquid suction & condensate	4-13	A-6	25	25	25	25	25

3.6 PIPING INSULATION SCHEDULES (Cont'd)

.5 (Cont'd)
.2 (Cont'd)

drain							
Refrigerant, liquid suction	below 4	A-6	25	25	38	38	38

.6 Finishes:
.1 Exposed indoors: aluminum jacket.
.2 Exposed in mechanical rooms: aluminum jacket.
.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 ABS jacket.
.6 Finish attachments: SS screws, 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.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 91 00 - Commissioning: General Requirements, supplemented as specified herein.

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.

.2 All performance and verification requirements should be included and performed prior to interconnection with existing steam heating system.

.3 Make arrangements and include costs to provide all required water for performance testing and verification prior to connecting to exiting steam and condensate system.

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:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures and interlocks, by simulating maximum design conditions and the following scenarios

.1 Multi Split system failure.

.2 Maximum heating demand.

.3 Single Pump Failure.

.4 Control interlocks with related equipment.

.5 Ventilation control interlocks.

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Timing: After:
.1 TAB has been completed
.2 Verification of operating, limit, safety controls.
.3 Verification of pump flow rates.
.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 When capacity test is completed, return controls and equipment status to normal operating conditions.

.4 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.5 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.
.2 Test procedures:
.1 Open heating coil and Hydronic control valves.
.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

1.6 TRAINING

.1 In accordance with Section 01 91 41, supplemented as specified herein.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 91 00 - Commissioning General Requirements.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheet (MSDS).

1.3 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 Provide a cleaning and flushing plan schedule as part of the overall commissioning schedule in GANTT chart format prior to commencing activities for review and approval by Departmental Representative.

1.4 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.

3.1 CLEANING HYDRONIC SYSTEMS (Cont'd)

.5 (Cont'd)
.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 Test Procedures:
.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 meter to record volume of water in system to +/- 0.5%.
.4 Add chemicals under direct supervision of chemical treatment supplier.
.5 Circulate system cleaner at 60° C for at least 36 h or as required by approved cleaning procedure report. 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).

3.2 START UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is flushed:
.1 Establish set pressure controls and establish condensate tank, deaerator tank are operational..

.2 Ensure a steady source of water is available.

3.2 START UP OF HYDRONIC SYSTEMS (Cont'd)

.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 Perform TAB as specified in Section 23 05 93.

.7 Adjust pipe supports, hangers, springs as necessary.

.8 Monitor pipe movement, performance of expansion joints, loops, guides, anchors. Monitor controls and mass flow meter on fuel.

.9 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.10 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.11 Check operation of drain valves and test valve connections.

.12 Adjust valve stem packings as systems settle down.

.13 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

.14 Perform preliminary star-up of all components prior to final commissioning activities.

.15 Provide all required temporary piping connections and equipment necessary for the proper and safe completion of start-up. Remove same upon successful completion of all commissioning activities in preparation for final tie-in work.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)
.1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME B16.4-2006, Grey Iron Threaded Fittings.
.2 ANSI/ASME B16.15-2006, Cast Bronze Threaded Fittings.
.3 ANSI B16.18-2001(R2005), Cast Copper Alloy, Solder Joint Pressure Fittings.
.4 ANSI/ASME B16.22-2001(R2005), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)
.1 ASTM B32-08, Standard Specification for Solder Metal.
.2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
.3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
.4 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube Metric.

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

.5 Manufacturers Standardization Society (MSS)
.1 MSS SP-67-2002a, Butterfly Valves.
.2 MSS SP-70-2006, Grey Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS SP-71-2005, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
.4 MSS SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
.5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include

1.2 SUBMITTALS (Cont'd)

.1 Product Data:(Cont'd)
.1 (Cont'd)
product characteristics, performance criteria, and limitations.
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.

.2 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00.
.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.2 Indicate on manufacturers catalogue literature the following: VALVES.

.3 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.
.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.4 Closeout Submittals:
.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.3 QUALITY ASSURANCE

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

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

1.4 MAINTENANCE

.1 Extra Materials:
.1 Furnish following spare parts:
.1 Valve seats: one for every 10 valves each size, minimum 1.
.2 Discs: one for every 10 valves, each size. Minimum 1.

1.4 MAINTENANCE (Cont'd)

.1 (Cont'd)
.1 Furnish following spare parts:(Cont'd)
.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.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.

.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.

PART 2 - PRODUCTS

2.1 TUBING

.1 Type B hard drawn copper tubing: to ASTM B88M, minimum 64% recycled content.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22, minimum 64% recycled content.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4, minimum 25% recycled content.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18, minimum 64% recycled content.

2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32, lead free.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.5 VALVES

.1 Gate Valves
.1 NPS 2 and under:
.1 Class 125, non- rising stem, solid wedge disc.
.1 Operators: manual.

.2 Globe valves:
.1 NPS 2 and under:
.1 Soldered or threaded ends to MSS Sp-80 class 125 1380 kPa (200 psi)WOG, bronze body, renewable disc, screwed over bonnet, and steel lever handle.

.3 Circuit Balancing valves, for TAB:
.1 NPS 2 and under:
.1 Where indicated on drawings: Manual externally adjustable bronze copper alloy body, globe style with shut off,with plug disc, nylon handle wheel and protective cap, PTFE seat, stuffing box gasket and flow measuring ports.
.2 Valve manufacturer to size the valves for flow rate indicated. Do not assume valves are equal to line size. Circuit balancing valves to be selected near midpoint range of adjustment. Pressure drop at selection point to exceed 1.5m (5ft).

.4 Drain valves: gate, Class 125 1380 kPa(200 psi), non-rising stem, solid wedge disc, each complete with a threaded outlet suitable for coupling connection of 20 mm (3/4") diameter garden hose and a cap and a chain.

.5 Swing check valves:
.1 NPS 2 and under:
.1 Threaded ends with union down stream to MSS-SP-80 Class 125 1380 kPa(200 psi)WOG, swing, bronze body with bronze disc and screw in cap.

.6 Ball valves:
.1 NPS 2 and under:
.1 2 piece standard port to MSS-SP-80, class 150, 2758 kPa 9400 psi) WOG broze body, stainless steel ball, PTFE packing,

2.5 VALVES (Cont'd)

.6 Ball valves:(Cont'd)

.1 NPS 2 and under:(Cont'd)

PTFE seal and steel lever handle, soldered, threaded or grooved ends.

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 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install gateor valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.3 VALVE INSTALLATION (Cont'd)

.4 Provide hose bibb drain valves at low points to drain coils and risers

3.4 CIRCUIT BALANCING VALVES

.1 Install flow balancing valves as indicated.

.2 Record setting n Tab report. Remove handwheel after installation and TAB is complete.

3.5 FLUSHING AND CLEANING

.1 Flush and clean in presence of Departmental Representative in accordance with section 23 08 02.

3.6 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified.

3.7 FIELD QUALITY CONTROL

.1 Testing:

.1 Test system in accordance with Section 23 05 93.

.2 Balancing:
.1 Balance water systems to within plus or minus 5 % of design output.
.2 Refer to Section 23 05 93 for applicable procedures.

3.8 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

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
.1 ASME B16.1-05 Gray Iron Pipe Flanges and Flanged Fittings.
.2 ASME B16.3-2006, Malleable Iron Threaded Fittings.
.3 ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
.4 ASME B16.9-2007, Factory-Made Wrought Buttwelding Fittings.
.5 ASME B18.2.1-1996(R2005), Square and Hex Bolts and Screws (Inch Series).
.6 ASME B18.2.2-1987(R2005), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A53/A53M-07, 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 E202-09, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).
.1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).
.1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
.2 CAN/CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
.1 MSS-SP-67-2002a, Butterfly Valves.
.2 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.

1.1 REFERENCES (Cont'd)

.5 (Cont'd)
.3 MSS-SP-71-2005, Cast Iron Swing Check Valves Flanged and Threaded Ends.
.4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
.5 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00.
.1 Indicate on manufacturers catalogue literature the following: VALVES.

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

1.3 QUALITY ASSURANCE

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

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.
.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 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.5 MAINTENANCE

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

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, minimum 25% recycled content, as follows:
.1 To NPS6: Schedule 40.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 Flanges: plain.

.3 Orifice flanges: slip-on raised face, 2100 kPa.

.4 Flange gaskets: to AWWA C111.

.5 Pipe thread: taper.

.6 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

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, minimum 25% recycled content.
.2 Steel: to ASME B16.5, minimum 25% recycled content.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3, minimum 64% recycled content.

2.4 VALVES

.1 Gate Valves
.1 NPS 2 and under:
.1 Class 125, rising stem, solid wedge disc.
.1 Operators: manual.

.2 Globe valves:
.1 NPS 2 and under:
.1 Threaded ends to MSS Sp-80 class 125 1380 kPa (200 psi)WOG, bronze body, renewable disc, screwed over bonnet, and steel lever handle.

2.4 VALVES (Cont'd)

.3 Circuit Balancing valves, for TAB:
.1 NPS 2 and under:
.1 Where indicated on drawings: Manual externally adjustable bronze copper alloy body, globe style with shut off,with plug disc, nylon handle wheel and protective cap, PTFE seat, stuffing box gasket and flow measuring ports.
.2 Valve manufacturer to size the valves for flow rate indicated. Do not assume valves are equal to line size. Circuit balancing valves to be selected near midpoint range of adjustment. Pressure drop at selection point to exceed 1.5m (5ft).

.4 Drain valves: gate, Class 125 1380 kPa(200 psi), non-rising stem, solid wedge disc, each complete with a threaded outlet suitable for coupling connection of 20 mm (3/4") diameter garden hose and a cap and a chain.

.5 Swing check valves:
.1 NPS 2 and under:
.1 Threaded ends with union down stream to MSS-SP-80 Class 125 1380 kPa(200 psi)WOG, swing, bronze body with bronze disc and screw in cap.

.6 Ball valves:
.1 NPS 2 and under:
.1 2 piece standard port to MSS-SP-80, class 150, 2758 kPa 9400 psi) WOG broze body, stainless steel ball, PTFE packing, PTFE seal and steel lever handle, soldered, threaded or grooved ends.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

3.1 PIPING INSTALLATION (Cont'd)

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.2 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install gateor valves at branch take-offs and to isolate each piece of equipment, and as indicated.

3.3 CIRCUIT BALANCING VALVES

.1 Install flow balancing valves as indicated.

.2 Record setting n Tab report. Remove handwheel after installation and TAB is complete.

3.4 CLEANING, FLUSHING AND START-UP

.1 Flush and clean in presence of Departmental Representative in accordance with section

3.5 TESTING

.1 Test system in accordance with sections 23 05 05 and 23 08 01.

3.6 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 for applicable procedures.

3.7 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.8 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 Boiler and Pressure Vessel Code (BPVC)-2010.
.2 Pressure Test Codes 25-2008-Pressure Relief Devices

.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 Grey 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.
.6 ASTM A240 - 11a / A240M - 11a Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

.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.

.4 American National Standards Institute:
.1 ANSI/ARI 410-2001: Forced-Circulation Air-Cooling and Air-Heating Coils.

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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.3 Shop Drawings:
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario for all listed products.

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 and return by manufacturer of pallets crates paddling and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical carbon steel pressurized diaphragm type expansion tank.

.2 Capacity: as indicated

.3 Size: as indicated.

.4 Diaphragm sealed in elastomer suitable for 115 degrees C operating temperature.

.5 Working pressure: 860 kPa with ASME stamp and certification.

.6 Air precharged to initial fill pressure of system).

.7 Base mount for vertical installation, lifting rings and NPT system connection.

.8 Supports: provide supports with hold down bolts and installation templates.

.9 Replaceable butyl diaphragm

2.1 DIAPHRAGM TYPE EXPANSION TANK (Cont'd)

.10 Air charging valve connection shall be provided to facilitate adjusting pre-charge pressure to meet actual system conditions.

2.2 AUTOMATIC AIR VENT

.1 Float vent: cast iron body and a cap, rated at 620 kPa working pressure,115 degrees C working temperature .

.2 Float: stainless stell float assembley and seal, and an EPDM valve head.

2.3 AIR SEPARATOR - IN-LINE

.1 Working pressure: 860 kPa.

.2 Size: as indicated.

.3 Mild steel body designed and constructed in accordance with Section VIII, Div 1 of the ASME Boiler and Pressure Vessel Code

.4 Tangential inlet and outlet connection, an NPT vent connection on top of the seperator and an NPT tapping on the bottom of the air separator to facilitate blow-down.

.5 The unit will operate for a working pressure of 1105 kPa (160psi) and a working temperature of 180 C (350F).

2.4 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, end screwed connections, Y pattern.

.2 Blowdown connection: NPS 1.

.3 Screen: stainless steel with 1.19 mm perforations.

.4 Working pressure: 860 kPa.

2.5 PRE-HEAT AND RE-HEAT COILS

.1 Capacity: as indicated on drawings.

.2 ANSI/ARI rated and certified, each drainable, self-venting, factory tested.

.3 Tubes and fins: 16 mm (5/8") OD horizontal continuous copper tubes permanently bonded to aluminum fins and equipped with same end supply and return pipe connections.

2.5 PRE-HEAT AND RE-HEAT COILS (Cont'd)

.4 Casing: flanged galvanized steel casings arranged to prevent air bypass around the coil and factory punched for duct connection flanges.

2.6 PRESSURE SAFETY RELIEF VALVE

.1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1035 kPa (150 psi) rated, capable of relieving the full output of the equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.

2.7 PIPING EXPANSION JOINTS

.1 Threaded, grooved or flanged expansion joints with multi-ply ASTM A240 T304 stainless steel bellows, A53 GRB carbon steel outer housing and anti-torque device. Each expansion joint is to be designed , detailed and location verified by the manufacturer. Submit shop drawings and calculations provided by the manufacturer for review.

2.8 PIPING ALIGNMENT GUIDES

.1 Prime coat painted black carbon steel pipe alignment guides sized and fabricated to suit the pipe size and the pipe insulation thickness.

2.9 PIPE ANCHORS

.1 Welded structural black steel anchors of a size and type to securely anchor the pipe at the point shown. Each anchor is to be designed and detailed by a professional structural engineer registered in the Province of Ontario.

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.

3.2 GENERAL (Cont'd)

.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 tappings 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.

3.4 AIR VENTS

.1 Install at high points of systems and at equipment connections.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 EXPANSION TANK

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type globe valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVE

.1 Install pipes as indicated on drawing in accessible location

.2 Run discharge pipe to terminate above nearest drain.

3.7 PRE-HEAT AND RE-HEAT COILS

.1 Apply sealer into all seams prior to assembly.

.2 Install to manufacturer's recommendations.

.3 Install access doors in the ductwork upstream and downstream of the coils.

.4 Pipe the coil drain to the floor drain.

3.8 PIPING EXPANSION JOINTS AND PIPING ALIGNMENT GUIDES

.1 Provide expansion joints/compensators in the piping where shown on reviwed Shop Drawings. Install in accordance with the manufacturer's instruction. Provide pipe alignment guides where shown, including double guides at each side of expansion compensators, with exact locations as per the expansion compensator supplier's recommendations.

3.9 PIPING ANCHORS

.1 Provide anchors to secure pipework to the structure where shown and/or specified. Anchors are to be in accordance with reviewed shop drawings.

3.10 PERFORMANCE VERIFICATION

.1 Operational requirements in accordance with section 23 08 01, include:
.1 Repair and maintenance materials and instructions.

3.11 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

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA-B214-07, Installation Code for Hydronic Heating Systems.

.2 National Electrical Manufacturers' Association (NEMA)
.1 NEMA MG 1-2009, Motors and Generators.

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 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 drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.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.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00.

1.4 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Supply spare parts as follows:
.1 Two sets of Gaskets for each pump.

1.5 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: in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Size and select components to: CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: alloy steel.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 °C.

.5 Coupling: rigid,self-aligning.

.6 Bearings: permanently lubricated stainless steel.

.7 Motor:
.1 Size: as indicated on drawings.
.2 Complying with the requirements of NEMA MG 1-2009, Motors and Generators.

.8 Capacity: as indicated on drawings.

.9 Design pressure: as indicated on drawings.

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-B214-07.

.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 floor 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 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.

3.3 START-UP (Cont'd)

.2 Procedures:(Cont'd)
.4 Check base for free-floating, no obstructions under base.
.5 Run-in pumps for 12 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 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 Multiple Pump Installations - Series and Parallel:
.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 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.

3.4 PERFORMANCE VERIFICATION (PV) (Cont'd)

.6 Commissioning Reports:(Cont'd)
.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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 23 05 05 - Installation of Pipework.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.22-2001(R2005), Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
.2 ASME B16.24-2006, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
.3 ASME B16.26-2006, Cast Copper Alloy Fittings for Flared Copper Tubes.
.4 ASME B31.5-2010, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials (ASTM)
.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)
.1 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada Workplace Hazardous Materials Information System(WHMIS).
.1 Material Safety Data Sheet (MSDS).

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 and suitable for R-410A, 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 15% Ag-80% cu-5%P, or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM 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.

PART 3 - EXECUTION

3.1 GENERAL

.1 In accordance with Section 23 05 05, supplemented as specified herein

.2 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

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

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:

.1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified above.

.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

.5 Longest possible lengths of copper pipe should be utilized to minimise joints on site.

.6 Approperiate refrigeration tools must be utilized.

.7 All pipes to be insulated. Insulation details in accordance with section 23 07 15. Pipes to be insulated separately.

3.3 PIPING INSTALLATION (Cont'd)

.1 General:(Cont'd)
.8 Pipes to be fixed and supported in accordance with section 23 05 29.
.9 Identification to be in accordance with section 23 05 53.01.

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.

3.5 DEHYDRATION AND CHARGING (Cont'd)

.7 Charging:(Cont'd)

.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 00 and CSA B52.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM A480-11a/A480M-11a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
.2 ASTM A635-09b/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
.3 ASTM A653-10/A653M-10, 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-09, Standard for the Installation of Air-Conditioning and Ventilating Systems.
.2 NFPA 90B-09, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.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 Guideline for Occupied Buildings Under Construction 2007, 2nd Edition.

.7 Transport Canada (TC).
.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

1.2 SUBMITTALS (Cont'd)

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
.1 Sealants.
.2 Tape.
.3 Proprietary Joints.

1.3 QUALITY ASSURANCE

.1 Certification of Ratings:
.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.
.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.4 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 A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
- .3 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, water borne, 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 or 0.5% at each major branch whichever is more stringent.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.
- .1 Rectangular: Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius. Centreline radius: 1.5 times diameter.

2.5 FITTINGS (Cont'd)

.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: with radius on branch 1.5 times width of duct or 45 degrees entry on branch.
.2 Round main and branch: enter main duct at 45 degrees with critical connections.
.3 Provide volume control damper in branch duct near connection to main duct.
.4 Main duct branches: with balancing dampers.

.5 Transitions:
.1 Diverging: 20 degrees maximum included angle.
.2 Converging: 30 degrees maximum included angle.

.6 Offsets:
.1 As indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.
.1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653-10/A653M-10, Z 275 zinc coating.

.2 Thicness, fabrication and reinforcement: to SMACA.

.3 Joints: to SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 33 00.
.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
.1 Maximum size duct supported by strap hanger: 500.
.2 Hanger configuration: to ASHRAE and SMACNA.
.3 Hangers: galvanized steel angle with galvanized steel rods to and ASHRAE and SMACNA and following table. Whichever is more stringent.

Duct Size (mm)	Angle Size (mm)	Rod Size (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
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.2 For steel joist:manufactured joist clampsteel plate washer.
.3 For steel beams: manufactured beam clamps:

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated

.3 Support risers in accordance with ASHRAE SMACNA, as indicated on drawings.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

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 ASHRAE SMACNA as follows: whichever is more stringent.

Duct Size (mm)	Spacing (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 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before performance insulation or concealment Work.

END

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.

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

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 0.66 mm thick with fabric clenched by means of double locked seams.

.2 Material:
.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m^2.

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 complete with safety chain.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.
.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated single thickness and double thickness without trailing edge, to recommendations of SMACNA and as indicated. Refer to Section 23 31 13.01 for areas of use.

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.

.5 Local test points on all main S.A. and R. A. ductwork runs and branchlines and as indicated as a minimum requirement.

2.6 BALANCING DAMPER QUADRANTS .1 Operating quadrants sets to be stainless steel 316 type with silicone gaskets seals, PVC coated S.S. 316 lever arm with wing type locking nut.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Flexible connections:
.1 Install in following locations:
.1 Inlets and outlets to Heat Recovery Ventilator in Building 3 - Adminstartion Building.
.2 Outlets of supply fan in Building 15 - SIS Building
.2 Length of connection: 125 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 1200 x 600 mm for person size entry.
.2 600 x 600 mm for servicing entry.
.3 300 x 300 mm for viewing.
.4 As indicated.
.2 Locations:
.3 Fire and smoke dampers.
.4 Control dampers.
.5 Devices requiring maintenance.
.6 Required by code.

3.1 INSTALLATION (Cont'd)

.2 Access doors and viewing panels:(Cont'd)
.7 Reheat coils.
.8 Elsewhere as indicated.

.3 Instrument test ports.
.1 General:
.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.2 Locate to permit easy manipulation of instruments.
.3 Install insulation port extensions as required.
.4 Locations.
.1 For traverse readings:
.1 Inlets and outlets of fan systems.
.2 Main and sub-main ducts.
.3 And as indicated.
.2 For temperature readings:.
.1 At inlet and outlet of coils.
.2 And as indicated.

.4 Turning vanes:
.1 Install in accordance with recommendations of SMACNA and as indicated.

END

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.

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

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate the following:.
  .1 Printed literature.
  .2 Specifications.
  .3 Data sheet.

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 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.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

2.2 SINGLE BLADE DAMPERS (Cont'd)

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: pin in bronze bushings.

.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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 23 33 00 - Air Duct Accessories.

.2 Section 25 00 00 - Automatic Control System.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)
.1 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate the following:
.1 Performance data.
.2 Actuation method and connection type.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

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.

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 MULTI-LEAF DAMPERS

.1 As indicated on drawings

.2 Operator: to Section 25 00 00.

.3 Performance:
.1 Leakage: in closed position to be less than 2% of rated air flow at 500 Pa differential across damper.
.2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, steel construction with nylon bearings, centre pivoted counterweighted, as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Install access door adjacent to each damper. See Section 23 33 00.

.4 Ensure dampers are observable and accessible.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 National Fire Protection Association -NFPA
.1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S112-M90(R2001), Standard Method of Fire Test of Fire Damper Assemblies.
.2 ULC-S505-1974, Standard for 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 Fusible links.
.3 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.

1.6 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.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, listed and bear label of ULC meet requirements of Fire Commissioner of Canada (FCC) and NFPA 90A-2009. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112-M90(R2001).

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
.2 Fire dampers: having dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 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. fusible links to be tested in accordance with S505.

.4 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.5 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.6 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.7 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.8 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

2.1 FIRE DAMPERS (Cont'd)

.9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing while complying with manufacturer's installation instructions.

.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

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CAN/CSA-C22.2 NO. 236-05 (R2009)Heating and Cooling Equipment (Bi-National Standard with UL 1995).

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Indicate following:
.1 Unit details including accessories.
.2 Heater capacity.
.3 Fan capacity.
.4 Control logic and interface to BMS.

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 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.

1.5 CERTIFICATION OF RATINGS

.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.

PART 2 - PRODUCTS

2.1 OUTDOOR AIR UNIT

.1 CSA/NRTL/C approved outdoor air unit.

.2 Capacity : as indicated on drawings.

.3 Casing: Corrosion resistant steel.

.4 Heater: Heating coils shall be of Hide Grade Nickel Chromium alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminals shall be stainless steel, insulated by means of non -rotating ceramic bushings.

.5 Fan:
.1 120V tube axial type with ball bearings for low noise and long life.
.2 Neutral connection for 120V fan motor.
.3 Connection is provided for exhaust fan (120V,3 amps).

.6 Accessories:
.1 High temperature automatic reset thermal cutout that will reset automatically after cool off.
.2 Built in Temperature Sensor controls the heater proportional ly to maintain the p re-set air temperature.
.3 Air flow Se nsor which will main tain maximum heating with normal air flo w, reduced heating c apacity with low air flow and no heating with no air flow.
.4 Built in Damper automatically opens when the heater is in operation.
.5 Round collars for easy connection to the ductwork and supply register.

.7 Control:
.1 Room controller allowing for intermittent operation of unit.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Verify available dimensions for installation in location indicated on drawings.

.2 Co-ordinate with all services and trades

.3 Install in accordance with manufacturer's recommendations.

3.2 ANCHOR BOLTS AND TEMPLATES

.1 Install in accordance with manufacturer's recommendations.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Heating and Cooling Controls: Section 25 00 00.

.2 Duct work: Section 23 31 13.01.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.3 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 air flow.

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 DUCT HEATERS

.1 Duct heaters: flange typeconstructed from heavy gauge corrosion -resistant metal with element support brackets spaced not more that 91.4 cm apart. NEMA 12 type with hinged clamped doors, linear type automatic reset thermal cutout for primary over temperature protection and an aixiliary linear type manual reset thermal cutout to protect the heater from overheating.

.2 Heater designed to cover the entire face of the coil to prevent stratification whne operating at less than full capacity.

.3 Elements:
.1 Finned tubular.
.2 Incoloy sheathed.

.4 Staging:
.1 Staged heaters: balanced line current at each stage.
.2 Each stage: uniform face distribution.

.5 Controls:
.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.
.2 Controls mounted in a CSA Type enclosure and to include:
.1 Magnetic disconnecting contactors.
.2 Door interlocking disconnect to break all ungrounded conductors with lockable feature.
.3 Built-in and factory wired pressure differential airflow switch set to open at 17.4 Pa (0.07 inches of water column) to shut-down the heater sensing a "low airflow" condition.
.4 Electric relays.
.5 Low voltage control circuit transformer(s) with fused primary and secondary.
.6 SCR controller.
.7 Wiring diagram attached to the inside of the heater's enclosure door.
.8 Panel layout drawing.
.3 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
.4 Thermostat shall be tamper proof dial type and shall be mounted in a tamper proof locakble

2.1 DUCT HEATERS (Cont'd)

.5 Controls:(Cont'd)

.4 (Cont'd)

metallic enclosure with pencil proof slots to allow for room temperature sensing.

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

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE 84-2008, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).

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

1.2 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. Unit must be supplied with the variable refrigerant volume split system as one package with full compatibility confirmed by the manufacturer.
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.

.2 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00.
.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Ontario.
.2 Indicate following:.
.1 Flow.
.2 Capacity.
.3 Static pressure.
.4 Sensible energy recovery efficiency.
.5 Latent energy Heat recovery effciency.
.6 Electrical ratings.

.3 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.

1.2 SUBMITTALS (Cont'd)

.3 Quality assurance submittals:(Cont'd)
.2 Instructions:(Cont'd)
.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.4 Closeout Submittals:
.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00. Full commissioning Logs shall be supplied by the Manufacturer's local distributor. These shall be completed fully and included with the main Installation and Operation Manuals prior to hand over. In addition, copy pages shall be returned to Manufacturer in order to ensure that the installation is logged and warranty honored.

.5 Certificates:
.1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
.2 Provide confirmation of testing.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.

.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.

1.5 MAINTENANCE

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Section 01 78 00.
.2 The manufacturer shall provide a one-year warranty on parts and a 10 year warranty on the energy recovery core.

1.5 MAINTENANCE (Cont'd)

.1 (Cont'd)
.3 Furnish list of individual manufacturer's recommended spare parts for equipment include:
.1 Bearings and seals.
.2 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Comply with ASHRAE 84.

2.2 ENERGY RECOVERY VENTILATOR

.1 Casing: galvanized sheet metal gauge and covered with polyurethane foam insulation. The internal construction shall be galvanized sheet metal and foamed polystyrene.

.2 Each unit shall have 2 centrifugal fans running simultaneously supplying and extracting air.

.3 Motor: Three speed.

.4 Heat exchange element: non-metallic and bacteriostatic with desiccant and coated with silicate. The element shall have filters at both the supply and exhaust sides with an access cover to allow easy maintenance.

.5 Purge section, maximum cross contamination of particulates: less than 1% between entering and leaving airstreams.

.6 Performance characteristics: as indicated on drawings.

.7 Temperature actuated by-pass damper. The mechanism of opening and closing the bypass damper shall be a 208V-230V synchronous electric motor through an actuator. The motor will drive a steel cable connected to an economizer damper flap to allow fresh air to bypass the Heat Exchange element. Supply and return air thermistors shall control the damper and be interlocked with the remote controller of the split air conditioning system.

.8 Controls:
.1 The Energy Recovery Ventilator shall be controlled by the variable refrigerant volume split system control network. The ERV shall be hard wired through the M-Net to the central

2.2 ENERGY RECOVERY VENTILATOR (Cont'd)

.8 Controls:(Cont'd)
.1 (Cont'd)
controller and have an addressable input and output. The ERV shall be initially set up to run based on an occupancy schedule as determined by the Departmental Representative. A local controller with over-ride capabilities shall be provided in the General office -121 in the Administration Building (WW03).

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 manufacturers recommendations.

.2 Support independently of adjacent ductwork with flexible connections.

3.3 FIELD QUALITY CONTROL

.1 Tests:
.1 Perform tests in accordance with Section 26 05 01.

3.4 PERFORMANCE VERIFICATION

.1 Performance Verification of the Energy Recovery Ventilator shall be part of the overall performance verification of the Variable Refrigerant Volume Split System.

3.5 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

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 23 23 00 - Copper Tubing and Fittings Refrigerant.

.2 Section 25 00 00 - Automatic Control System

1.2 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
.1 ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 National Fire Protection Association (NFPA)
.1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.

.3 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ASHRAE Standard 15-2001, Safety Standard for Refrigeration Systems.

.4 Canadian Standards Association (CSA International)
.1 CAN/CSA-C22.2 NO. 236-05 (R2009) - Heating and Cooling Equipment.
.2 CAN/CSA-C273.5-11 - Installation of Air Source Heat Pumps and Air conditioners.

.5 American National Standards Institute (ANSI): . 1 ASME B16.26-2006 - Cast Copper Alloy Fittings for Flared Copper Tubes.

.6 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.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.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. Unit must be supplied with the variable refrigerant volume split system as one package with full compatibility confirmed by the manufacturer.

1.3 SHOP DRAWINGS AND PRODUCT DATA (Cont'd)

.1 Product Data:(Cont'd)
.1 (Cont'd)
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.

.2 Indicate:
.1 Capacities.
.2 ARI Ratings.
.3 Sound Power levels.
.4 Installation instructions.
.5 Start-up Instructions.
.6 O&M, Instructions.

.3 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.
.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.4 Closeout Submittals:
.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00. Full commissioning Logs shall be supplied by the Manufacturer's local distributor. These shall be completed fully and included with the main Installation and Operation Manuals prior to hand over.

1.4 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 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.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

1.5 WARRANTY

.1 For heat pumps, the 12 months warranty period prescribed in GC3.13 of General Conditions is extended to 5 years. Copy pages of the commissioning logs shall be returned to Manufacturer in order to ensure that the installation is logged and warranty honored.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Heat pumps: EPS 1/RA/2, CSA approved and carry ARI or CSA certification seal.

2.2 REFRIGERANTS

.1 Type of Refrigerant: R-410A.

2.3 AIR-SOURCE HEAT PUMP - BUILDING 2 SECURITY POST

.1 General:
.1 Three component units consisting of refrigerant compressor section, outdoor unit and indoor coil for use with R-410A.

.2 Performance data: as indicated on drawings.
.1 Ratings: in accordance with. CAN/CSA-C22.2.

.3 Outdoor unit:
.1 L shaped Aluminum plate fins mechanically bonded to copper tubing.
.1 Factory-installed refrigerant metering device with internal components removable for servicing mounted on liquid service valve.
.2 Brass service valves with refrigerant line fittings, terminating at exterior of casing.
.2 Protect coil by vinyl-coated steel grille.
.3 Fan: propeller, direct driven, perminently lubricated from factory, inherently protected, resiliently mounted motor, drawing air through the coil.
.4 Casing: galvanized steel plate treated with rust coating and finished with ivory colour acrylic paint, easily removable panels arranged for servicing all components.
.5 The outdoor unit shall have a three minute time delay before compressor restart.
.6 The outdoor unit shall have sufficient oil return without the use of refrigerant pipe traps.

2.3 AIR-SOURCE HEAT PUMP - BUILDING 2 SECURITY POST (Cont'd)

.3 Outdoor unit:(Cont'd)

.7 Sound rating number (SRN): not to exceed 17 at full capacity.

.4 Compressor section:

.1 Compressor: welded hermetic with variable compressor speed inverter technology, internal vibration isolation. The compressor crankcase shall be heated by intermittent low speed compressor motor rotation, 'slugging' protection, internal high pressure protection, motor having thermal and current sensitive overload devices.

.2 Other components to include: reversing valve, suction line accumulator, liquid line filter-drier,, refrigerant line tubing, fittings and service ports.

.3 Controls: mounted on this section and supplemented as specified in the indoo nit section:

.1 Include low pressure switch, compressor malfunction warning device.

.4 Install in the outdoor unit.

.5 Indoor unit:

.1 For installation in security post of Building 2.

.2 Coil:

.1 Aluminum fins mechanically bonded to copper tubing.

.2 Factory installed brass service valves, refrigerant line flare brass fittings meeting ANSI B16.26 standards terminating at exterior of casing.

.3 Factory installed condensate pan, and drain pump to be provided.

.3 Casing:

.1 ABS plastic and have a white finish.

.4 Controls:

.1 The unit shall have a multi-language large DOT liquid crystal display wired contr oller with micro processor controls to perform input functions necessary to operate the system.

.2 The controller shall have a built in room temperature sensor.

.3 The controller shall have auto change over between heating and cooling modes.

.4 The system shall be capable of automatic restart when power is restored after interruption.

.5 The wired controller shall provide 7 day programmable time schedule with tem perature set back and system on/off operation.

2.3 AIR-SOURCE HEAT PUMP - BUILDING 2 SECURITY POST (Cont'd)

.5 Indoor unit:(Cont'd)

.4 Controls:(Cont'd)

.6 The controller shall provide system error diagnostic and operation data.

.7 The system be integrated with existing BACS (LonWorks, BacNet). The control valve of the Wall Fin Heater shall also be controlled by the BACS. The control sequence shall have the wall fin heater operate as primary heat source with the heat pump operating in assist/standby mode.

.8 The microprocess or control signal be tween the indoor and outdoor unit shall be incorporated with the indoor unit's electric supply requiring a minimum of 4 wire (3+gnd.) 14AWG cable..

.6 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.

PART 3 -EXECUTION

3.1 INSTALLATION

.1 Install where indicated and in accordance with NFPA 90A,CAN/CSA-C273.5 and manufacturer's instructions.

.2 Install outdoor units on roof with vibration isolation providing 95% isolation efficiency. For flashing, roofing, weatherproofing, refer to Architectural details. Secure with hold-down bolts. Level unit with fans running. Make piping connections.

.3 Co-ordinate all installations of indoor units with the Architectural details. Level all units. Connect the refergirent and drainage piping. Install so that no water can accumulate and that drainage pupms operate properly, arrange for easy access for cleaning.

.4 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.2 START-UP AND COMMISSIONING

.1 Manufacturer to certify installation.

.2 Manufacturer to test and start up units and certify performance.

.3 Manufacturer to provide verbal,, and written instructions to operating personnel.

.4 Submit written report to Departmental Representative.

END

PART 1. GENERAL

1.1 Related Sections

.1 Section 23 23 00 - Copper Tubing and Fittings-Refrigerant.

.2 Section 25 00 00 – Automatic Control System.

1.2 References

.1 Air-Conditioning and Refrigeration Institute (ARI)

.1 ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.3 ASHRAE Standard 15-2001 Safety Standard for Refrigeration Systems.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 NO. 236-05 (R2009) - Heating and Cooling Equipment.

.2 CAN/CSA-C273.5-11 - Installation of Air Source Heat Pumps and Air conditioners.

.1 American National Standards Institute (ANSI): .

.3 ASME B16.26-2006 - Cast Copper Alloy Fittings for Flared Copper Tubes.

.2 Environment Canada, (EC)/Environmental Protection Services (EPS)

.4 EPS 1/RA/2-[1996], Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.5 Environment Canada-[1994], Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 Shop Drawings And Product Data

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario.

.3 Indicate:

.1 Capacities
.2 ARI Ratings
.3 Sound Power levels
.4 Installation instructions.
.5 Start-up Instructions
.6 O&M, Instructions.
.7 Accessories.
.8 Power and control wiring schematics.
.9 Piping schematics.

.4 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. Manufacturer to also certify the final installation prior to testing and commissioning.

.2 Instructions: submit manufacturer's installation instructions.

.6 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.3 Reports: Manufacturer shall conduct site visits and shall produce field reports confirming installation is complying with manufacturer’s installation requirements at 10%, 30%, 60% and 90% of the construction phase of the project.

.4 Closeout Submittals:

.7 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

.5 Certificates:

.8 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.

.9 Provide confirmation of testing.

1.4 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 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.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

1.5 Warranty

.1 For heat pumps, the 12 months warranty period prescribed in GC3.13 of General Conditions is extended to 5 years.

PART 2. PRODUCTS

2.1 General

.1 The system is to be a 2 pipe simultaneous heating & cooling equipment with individual zones c/w wall mounted controllers. Alternate 3 pipe systems must show savings in installed overall mechanical & electrical costs.

.2 Heat pumps: EPS 1/RA/2, CSA approved and carry ARI or CSA certification seal.

.3 Performance data: as indicated on drawings.
.1 Ratings :in accordance with. CAN/CSA-C22.2

.4 The units shall be listed by Electrical Laboratories (ETL) and bear the cETL label.

.5 The system shall consist of variable speed drive compressors capable of supplying up to fifty (50) indoor fan coil units based on a series of modular outdoor units to provide simultaneous heating and cooling. The system shall be based on using R-410A refrigerant

.6 The indoor evaporator section and outdoor condensing section shall be as specified in the Equipment Schedules.

.7 The system must be installed by the manufacturer’s factory trained contractor/dealer.

.8 The wiring shall be in accordance with the National Electric Code (NEC).

.9 The system should be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

.10 The system shall automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

2.2 Outdoor Units

.1 Consists of one or two high efficiency modular air-cooled outdoor unit(s). Each module rated for the designated proportion of the total system cooling/heating capacity. Each module is furnished with an inverter driven scroll compressor and inverter driven variable speed propeller type condenser fan. Single compressor individual outdoor condensing units with capacities in excess of 144,000 Btu's are not acceptable for this application based on reduced operational life cycles and limited compressor redundancy levels. The modular outdoor unit combinations are designed so as to balance the run hours seen by each individual inverter driven scroll compressor in order to extend overall outdoor unit life cycle and reduced ongoing maintenance costs. The modules shall be installed in a side by side configuration without the need for intermediate oil balancing pipe work. Alternate modular systems which require additional on site oil balancing infrastructure between modules shall not be deemed appropriate for this application.

.2 Modular units will be piped together in the field using a factory supplied twinning kit. Once connected they shall operate as one unit alternating compressor run cycles to balance total compressor operation hours. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity. with the option of extending the connected capacity to 200% with additional software. If the indoor unit connected design capacity exceeds 120%, manufacturer to provide a design review report to departmental representative.

.3 The compressor motor shall be of DC Brushless configuration with auto tuning inverter control to achieve optimum compressor/motor performance levels particularly during off design conditions. Non inverter-driven compressors shall not be deemed acceptable for this application. Compressors driven by induction are not allowed in this instance. A crankcase heater(s) shall be factory mounted on the compressor(s). Each compressor shall be capable of modulation down to 19% of rated capacity. The compressor shall be equipped with an internal thermal overload. The compressor shall be mounted to avoid the transmission of vibration

.4 Equipped with multiple circuit boards that interface with the manufacturer's control system shall perform all functions necessary for operation. The outdoor units shall be completely factory assembled, piped and wired. Each unit shall be thoroughly run tested at the factory without exception.

.5 Shall have a sound pressure level (SPL) rating no higher than a maximum of 63 dB(A) as measured from a horizontal distance 1 m from the unit. The system or combination of modular units shall have a low sound operational mode where the SPL rating is no higher than 53 dB(A).

.6 Shall have an accumulator with refrigerant level sensors and controls, shall have a high pressure safety switch, over-current protection and DC bus protection. The outdoor units shall have the ability to operate with a maximum height difference of 164 feet and can, when combined in a modular format have a total refrigerant tubing length of 1,804 - 2,624 feet when serving up to Qty 50 indoors units. The greatest length is not to exceed 541 feet between the outdoor unit and the indoor units without the need for line size changes or traps. The installing contractor is to confirm system layout limitations and piping sizes with the Manufacturer's representative. The modular variable speed drive outdoor unit shall have rated performance for operation in heating and cooling mode as detailed is the product technical data sheets. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained

.7 Furnished with direct drive, inverter driven, variable speed propeller type fans. The unit shall be manufactured and factory set for operating under 0 'WG external static, but capable of operation under a maximum of 0.24" W.G external static via a dipswitch setting. Fan motor shall have inherent protection and permanently lubricated bearings and be mounted. Fan shall be provided with a fan guard to prevent contact with moving parts. Fan shall have multiple speed operation with vertical discharge configuration.

.8 Cabinet casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel. The outdoor unit shall be completely weatherproof and corrosion resistant, and be able to withstand 960 hours of Salt Spray.

.9 The following safety devices shall be included on the condensing unit: high pressure switch, control circuit fuses, crankcase heaters, fusible plug, low pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

.10 Coil shall be of the wrap around configuration with nonferrous construction with lanced or corrugated plate fins on copper tubing A minimum clearance of 35 mm (1 3/8") shall be allowed between modular units to facilitate sufficient air flow across the wrap around condenser coils. The coil fins shall have a factory applied corrosion resistant blue-fin finish. The outdoor coil shall include multiple circuits with two position valves for each circuit, except for the last stage. The coil shall be protected with an integral metal guard. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

.11 Electrical power shall be 208/230 volts, 3 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz). The outdoor unit shall be controlled by integral microprocessors. The inrush current to the outdoor unit shall not

exceed the design full load amp FLA rating for the unit. Alternate systems with solid state or constant speed scroll compressors with significant inrush current characteristic will not be acceptable for this application.

.12 As required by the manufacturer, factory manufactured twinning kits will be supplied loose to facilitate the field connection of a maximum of two (2) modular condensing units per system. The low pressure side twinning kits are installed in the master unit.

2.3 Indoor Units

.1 Total capacity of the indoor units shall be between 50 and 150% of the capacity of the outdoor unit. Each indoor unit will have a heat exchanger which shall be constructed from copper tubing with aluminium fins. The flow of refrigerant through the heat exchanger will be controlled by a linear expansion valve. This valve will be controlled by two pipe thermistors and a return air thermistor and shall be capable of controlling the variable capacity of the indoor unit between 25% and 100%.Each indoor unit will require a 208-230 vac power supply. Control will be via the 30 VDC M-net data control signal from the outdoor unit.

.2 Type and capacity shall be as indicated on the drawings. The unit shall be used with a heat recovery outdoor heating/cooling unit. The unit shall support individual control using the manufacturer supplied DDC controllers. Units shall control supplemental heat via connector CN24 and a 12 VDC output as detailed in section 25 00 00.

.3 Factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

.4 Fan:

.1 Wall mounted units: The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

.2 Ceiling Cassette Units: The indoor fan shall be an assembly with a turbo fan direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall consist of five (5) speed settings, Low,

Mid1, Mid2, High and Auto. The 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. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space

.5 Cabinet:

.1 Wall mounted units: The casing shall have a white finish. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard. There shall be a separate back plate which secures the unit firmly to the wall.

.2 Ceiling Cassette Units: The cabinet shall be space-saving ceiling-recessed cassette. The cabinet panel shall have provisions for a field installed filtered outside air intake. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

.6 Return air shall be filtered by a manufacturer supplied filter as indicated on drawings.

.7 Coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The Condensate Drain Pump shall be factory installed as a standard for ceiling cassettes type units and shall be supplied for field installation on the wall mounted units. Connection to coil shall be through refrigerant line flare brass fittings meeting ANSI B16.26 standards terminating at exterior of casing.

.8 Both refrigerant lines to the indoor units shall be insulated.

.9 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

2.4 Branch Controller

.1 Specifically used with manufacturer's R-410A systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The branch controllers shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity. The branch controllers (s) shall be selected by the Manufacturer based on the Equipment schedule and System Configuration as shown on the drawings.

.2 Constructed from galvanized steel plate partially insulated with polyurethane foam. The base of the unit shall have a foamed polystyrene tray. The master branch controllers shall be connected to the outdoor unit via a high pressure and low pressure pipe. The master branch controllers shall include a gas/liquid separator, which will separate high pressure liquid and high pressure gas. A brass header pipe with three solenoid valves for each distribution port shall distribute the correct phase of refrigerant to each indoor unit.

.3 Shall also include a tube in tube heat exchanger which will recover waste heat from units in cooling operation and distribute this to units requiring heating. The opposite will happen in cooling operation. An integral condensate pan and drain shall be provided. The refrigeration process in the branch controllers shall be maintained by LEV's (linear expansion valves) which will be controlled by pressure and temperature sensors.

.4 Shall have different amounts of distribution ports depending on the number of indoor units it is serving, The master branch controller will have the ability to connect to either one or two sub controllers. The sub controller model will connect to the master controller via 3 pipes, high pressure pipe, liquid pipe and a low pressure pipe. The sub controller will have four, eight or sixteen of distribution pipes ports. A brass header pipe with three solenoid valves for each distribution port shall distribute the correct phase of refrigerant to each indoor unit. Control will be via the 30 V DC signal from the outdoor unit. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and/or three indoor units. Branches may be twinned to allow more than 54,000 BTUH. Each branch shall have multiple two-position valves to control refrigerant flow. Service shut-off valves provided by the manufacturer shall be field installed for each branch to allow service to any indoor unit without field interruption to overall system operation. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

.5 Provide a power input of 208-230/1/60 VAC mains supply for each branch controller.

2.5 Controls

.1 General:

.1 This system shall use a control network provided by Manufacturer to perform all functions necessary to operate the system. The controls/control network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

.2 Control wiring shall be installed in a system daisy chain configuration from indoor unit to remote controller to indoor unit, to the branch controller (main and sub) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

.3 Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply module.

.4 Wiring shall be 2-conductor (16 AWG or 18 AWG), twisted shielded pair, stranded wire. Network wiring shall be CAT-5e with RJ-45 connection.

.5 The Energy Recovery Ventilator shall be controlled by the variable refrigerant volume split system control network. The ERV shall be hard wired through the M-Net to the central controller and have an addressable input and output. The ERV shall be initially set up to run based on an occupancy schedule as determined by the Departmental Representative. A local controller with over-ride capabilities shall be provided in the General office -121 in the Administration Building (Building 3).

.6 The control valves of the Wall Fin Heaters shall be controlled by the variable refrigerant volume split system control network. The necessary wiring shall be provided between the valve, indoor unit, remote controller and centralized controller as required by the manufacturer.

.2 Remote Controller:

.1 Capable of controlling up to 16 indoor units (defined as 1 group), shall be compact in size, and have limited user functionality. It should support temperature display selection of Fahrenheit or Celsius, allow the user to change on/off, mode (cool, heat, auto , dry, and fan), temperature setting, and fan speed setting. The centralized group controller shall be able to limit the set temperature

range from the remote controller. The room temperature shall be sensed at either the remote controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The remote controller shall display a four-digit error code in the event of system abnormality/error.

.2 Shall only be used in same group with other remote controllers, with up to two remote controllers per group.

.3 Shall require no addressing, shall connect using two-wire, stranded, non-polar control wire to connection terminal on the indoor unit. , shall require cross-over wiring for grouping across indoor units.

.3 Centralized Controller:

.1 Features a 9” wide color LCD touch panel. The settings can be adjusted by touching the corresponding icons on the LCD display.

.2 Shall be capable of being networked with other system controllers for web based control.

.3 Shall be capable of controlling a maximum of 50 indoor units across multiple outdoor units. The Centralized Controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly scheduling, monitoring of operation status, operation cycles(defrosting..etc..) and malfunction monitoring. The Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto , dry, and fan), temperature setting, fan speed setting, and airflow direction setting. Since this provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.

.4 Has the provision for web function, which enables the air conditioner system management on a PC browse screen. The system management can be undertaken via standard telephone line or internet connection. Working in tandem with centralized control software it functions such as “charging”, “Peak-cut”, “Energy Saving”, “General Equipment Management”, “Scheduling” etc should be available. Web functions, alarm email containing address and error code can be sent to appointed email addresses upon any fault condition identified in the air-conditioning system.

PART 3. EXECUTION

3.1 Manufacturer's Instructions

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. Refrigeration piping detail must be confirmed with the manufacturer before installation.

3.2 Installation and Performance Verification

.1 The fixing of all air conditioning equipment, installation of all refrigerant pipe work, inter-connecting wiring and full commissioning shall be performed by a specialist refrigerant installer and a commissioning agent who shall be authorized to install and commission variable refrigerant flow systems. The manufacturer shall provide the testing and commissioning procedures for compliance by the Contractor and the Commissioning agent. Procedures shall include the necessary testing and interlocking of the Energy Recovery Ventilator and the Wall Fin Heaters. Performance verification shall be conducted by a technician authorized by the manufacturer to commission the system and provide training for the operators.

.2 Full commissioning Logs shall be supplied by the Manufacturer’s local distributor. These shall be completed fully and included with the main Installation and Operation Manuals prior to hand over. In addition, copy pages shall be returned to Manufacturer in order to ensure that the installation is logged and warranty honored.

.3 Install where indicated and in accordance with NFPA 90A,CAN/CSA-C273.5 and manufacturer's instructions.

.4 Manufacturer shall conduct regular site visits during the installation stage of the project to allow him to verify that installation methods are fully in accordance with his requirements and that the equipment warranties will not be invalidated.

.5 Install and test the pipe works in accordance with section 23 05 05 and section 22 13 17.

.6 All pipe work to be insulated in accordance with section 23 07 15

.7 Refrigerant (R-410A) charge weight must be calculated, to the actual installed length of pipe work in accordance to Manufacturer

recommendations prior to charging the system. The charging should be carried out with an appropriate charging station.

.8 A condensate line shall be installed to each indoor unit in accordance with section 22 13 17. This shall be installed and insulated all as per the standard specification. Minimum size of condensate pipes to be 25mm (1 inch).

.9 Condensers shall be complete with feet and mounting frames and secured to precast concrete paving slabs. Install units on a flat surface level within 3mm. Provide intermediate supports recommended by the equipment manufacturer.

.10 Indoor units shall be supported from the structure or from the wall with the use of the back plate per the manufacturer's recommendations. Units shall not be allowed to rest on joists.

.11 The branch controllers shall be located in accordance with manufacturer's requirements.

.12 The system and individual controllers shall be located in a final location to be reviewed by the departmental representative prior to installation. Contractor to provide a shop mark-up of the locations for review.

.13 Provide certified wiring schematics to the divisions 25 and 26 for associated equipment and controls.

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.

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 25 00 00 - Automatic Control System.

.2 Section 26 05 01 - Common Work Results for Electrical Minor Works.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.

1.3 PRODUCT DATA

.1 Submit product data sheets for baseboard convectors. Include:
.1 Product characteristics.
.2 Performance criteria.
.3 Mounting methods.
.4 Physical size.
.5 kW rating, voltage, phase.
.6 Cabinet material thicknesses.
.7 Limitations.
.8 Colour and finish.

.2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

.3 Indicate recycled content of base materials.

1.4 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for baseboard convectors in accordance with Section 01 78 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20 and with Waste Reduction Workplan.

.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.

1.5 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.5 Collect, package and store existing convectors units for either reuse or recycling and return to recycler in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 BASEBOARD CONVECTORS

.1 Heaters: to CSA C22.2 No.46 standard wattage density as indicated with connection boxes on both ends.
.1 Stainless steel element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in stainless steel sheath.

.2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.

.3 Cabinet: to CSA C22.2 No.46 heavy duty suitable for meduim security applications, pre-drilled back for securing to wall with integral parts protected by louvre grill with pencil proof openings.
.1 Front inlet/front outlet.
.2 Panel: steel, metal thickness, bottom 2 mm, front 2 mm thick.
.3 Finish: phosphatized and finished with epoxy polyester powder coated finish, colour as per departmental representative's requirement.

2.2 CONTROLS

.1 Integral tamper proof thermostats of 30 A rating, adjustable with a screw driver, 1 pole to control load as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install baseboard convector heaters, and controls.

.2 When wireway is used, remove knock-outs and insert insulating bushing between units.

.3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.

.4 Make power and control connections.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01.

.2 Ensure heaters and controls operate correctly.

END

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 Special enclosures.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 SAMPLES

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

.2 Submit 1200 mm length sample enclosure showing method of securing to structure and connecting to adjacent length of enclosure.

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 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 87.25°C average water temperature, 11.5°C temperature drop and 18.3°C at entering air temperature.

2.2 FINNED TUBE RADIATION

.1 Heating elements: NPS 32mm (1 1/4") seamless copper tubing, 1.5 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 mm x 100 mm nominal, 164 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: 1.6 mm thick steel complete with components for wall-to-wall or complete 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 as indicated. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of grilles located to provide easy access to valves and vents. Enclosure panels to be removavble with possible provision for access doors for valvesand vents. Finish cabinet with factory applied baked primer coat.

.4 Special enclosures: Rated for meduim security applications in Inmate Waiting room of Building 3, as indicated on drawings.
.1 Enclosure: 3 mm.
.2 Inside and outside corners fit flush with enclosure.
.3 Interior butt joiners that assure no exposed fasteners.

.5 Dimensions for enclosures: measure site conditions. Do not scale from drawing.

.6 Provide for noiseless expansion of all components.

.7 Fully adjustable, plate type, knob operated control dampers located behind the front grille

2.2 FINNED TUBE RADIATION (Cont'd)

.7 (Cont'd)
and integral with the front panel of the enclosure.

.8 Controls:
.1 Administration Building (Building 3): The control valves of the Wall Fin Heaters shall be controlled by the Variable Refrigerant Volume Split System control network. The necessary wiring shall be provided between the valve, indoor unit, remote controller and centralized controller as required by the manufacturer. Valve types and operators shall be as indicated on drawings and as specified in section 23 21 13.01 and section 25 00 00.
.2 Security Post (Building 2): The control valve of the Wall Fin Heater shall be controlled by the BACS. The control sequence shall have the wall fin heater operate as primary heat source with the heat pump operating in assist/standby mode.

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 ball valves on inlet and circuit balancing valve and fail open control valve on outlet of each unit or group of units as indicated on Hydronic Schematic.

3.1 INSTALLATION (Cont'd)

.7 Venting:

.1 Install screwdriver vent terminating flush with surface of cabinet.

.8 Clean finned tubes and comb straight.

.9 Install flexible expansion compensators as indicated.

END

PART 1 - GENERAL

1.1 GENERAL

.1 The "provide" in this Division shall be interpreted as "supply, install, and connect".

.2 Energy Monitoring and Control System (EMCS) shall include Direct Digital Control (DDC), of mechanical systems as specified for this project.

.3 Building Automation System and Control(BACS) shall include the EMCS as specified for this project.

1.2 DESCRIPTION OF SYSTEM

.1 Extend the existing Networked DDC Control System to provide the specified control operation. The upgraded Control System shall consist of but is not limited to the following:
.1 Modification of the existing data communication network for Building Automation System (BAS) data transmission, as required.
.2 Addition of the new BAS points to displays and creation of new graphics for display on existing Operator workstations and operator interface devices as specified.
.3 DDC Controllers including Master Control Units and Local Control Units and Terminal Control Units as specified.
.4 Software required to implement a complete and operational system.
.5 Input and output control devices including sensors, actuators, conduit and wiring, as required to provide the operation specified.

1.3 ACCEPTABLE SYSTEM MANUFACTURERS AND PRODUCTS

.1 System Manufacturer shall have maintained a local office within 400 kilometers of job site for at least 5 years with technical staff to provide technical information, routine and emergency maintenance on the system and all system components, and to provide training instructions to O&M staff.

.2 System Manufacturer shall have proven record of successful experience on projects of similar type and size.

.3 Within 10 working days after bid closing, the winning bidder shall submit the following

1.3 ACCEPTABLE SYSTEM MANUFACTURERS AND PRODUCTS (Cont'd)

.3 (Cont'd)
information for review by Departmental Representative:
.1 Location of local office.
.2 Names and phone numbers of technical staff.
.3 Specification sheets for Master Control Units, Local Control Units and Terminal Control Units.
.4 Data communication network performance information indicating impact on existing network of the addition of the additional points added including data rate, display refresh rates and ability to accommodate additional nodes on the Local Area Network (LAN).
.5 Item-by-item statement of compliance.

.4 The proposed System Manufacturer and its products will not be considered acceptable until a satisfactory review report is issued from the Departmental Representative. Submissions with insufficient information will be returned without review.

.5 The existing BACS is a Delta Controls product provided by Taugher Controls.

1.4 CO-ORDINATION

.1 The Control Contractor shall co-ordinate its work with Mechanical and Electrical Trades. Unless noted otherwise, the Control Contractor shall provide all interface devices, control wiring and controls as required to provide the control operation specified.

.2 Control dampers, control valves and temperature control sensing wells shall be supplied by Control Contractor and installed by Mechanical Contractor under the supervision of Control Contractor.

.3 Unless noted in Division 26, the Control Contractor shall provide line voltage and low voltage control wiring for equipment specified in Division 25. Refer to Division 26 for power wiring, starters, disconnect switches, etc., to be provided for mechanical equipment.

.4 The Control Contractor shall provide all necessary power and dedicated circuits as required from local 120 volt branch circuits panel board for all Master Control Units, Local Control Units, Terminal Control Units and

1.4 CO-ORDINATION (Cont'd)

.4 (Cont'd)
Operator Workstations. Install tamper locks on breakers of circuit panel.

.5 Unless noted otherwise, all other installation work required for the complete installation of EMCS, including all interface devices, control and power wiring, controls and controlled devices shall be provided by the Control Contractor.

1.5 LOCKABLE PANELS

.1 Provide lockable panel for each MCU or LCU. All panels shall be EEMAC rated to environment requirements with hinged doors.

.2 All panels for Master Control Units shall be equipped with standard keyed-alike cabinet locks, keyed to same key.

1.6 NAMEPLATES

.1 Nameplates shall be provided for all control items listed or shown in the submittal and approved control diagrams.

.2 All panels and items mounted on panel face shall be identified by laminated plastic nameplates 3 mm thick. The lettering shall be accurately aligned and engraved into the white core. Size of nameplates shall be 20 mm by 100 mm minimum. Lettering shall be minimum 5 mm high normal black lettering.

.3 Field Sensors and Controlled Devices shall be identified by plastic encased cards attached to the device by chain.

.4 Warning signage: Each motor starter under remote automatic control (DO point on I/O Point Schedules) shall be provided with signage warning of automatic starting under control of EMCS. (i.e. "Caution - this equipment is under automatic remote control of EMCS").

1.7 SHOP DRAWINGS

.1 Submit shop drawings and product data in accordance with Section 01 33 00. Control shop drawings must be submitted within 15 days of award of contract.

1.7 SHOP DRAWINGS (Cont'd)

.2 Shop drawings shall include:
.1 BAS network cable layout showing cable routing, distance information and cable specifications.
.2 BAS network architecture diagram showing all Operator Workstations, Master Control Units, Local Control Units, Terminal Control Units and all other network components with new control components clearly delineated from existing.
.3 Description of network data transmission method and access method. Network performance information shall include network protocols to be used, data rate, maximum number of nodes per Local Area Network (LAN).
.4 System capacity and limits of expansion.
.5 Description of software programs included.
.6 Specification sheets for each piece of equipment or control devices to be provided.
.7 Equipment and DDC Controllers location drawings.
.8 Mechanical control schematics.
.9 Sequence of operation for each mechanical system.
.10 DDC control point schedules.
.11 Wiring diagrams indicating interrelationship between BAS components (e.g. relays) and electrical components such as starters.

1.8 INSTALLATION AND COMPLETION TESTS

.1 Installation and Calibration:
.1 Set control points and calibrate sensors immediately after installing controls.

.2 Completion Tests:
.1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and operation of equipment.
.2 Check and calibrate each AI using a calibrated digital thermometer, humidistat, velometer or transducer.
.3 Check each DI to insure proper settings and switching contacts.
.4 Check each AO to insure proper operation of valves and dampers. Verify tight closing, input and output signals.
.5 Check each DO to insure proper operation and lag time.
.6 Check all operating software.
.7 Check all application software. Provide samples of all logs and commands.
.8 Debug all software.

1.8 INSTALLATION AND COMPLETION TESTS (Cont'd)

.2 Completion Tests:(Cont'd)
.9 The contractor shall be responsible for fine tuning and adjusting all control devices and make modifications as required to provide a fully operational EMCS.
.10 Submit test report with checklist showing all input/output control points and all software programs.

.3 All reported results are subject to the spot checks by the Departmental Representative.

.4 The Departmental Represenative will select, at random, up to 30% of all reported results for verification, and a failure of selected item shall result in the rejection of the completion testing. The completion testing shall be repeated after corrective measures are carried out and continue until test results are acceptable.

1.9 SYSTEM STARTUP VERIFICATION TESTING

.1 The Contractor shall provide technical personnel and instrumentation to conduct startup verification testing.

.2 Verification:
.1 Perform point-by-point verification of entire system.
.2 Verify the calibration of all AI devices individually.
.3 Verify the calibration of all DI devices individually.
.4 Verify all AO devices are functional, start and span are correct, direction and normal positions are correct.
.5 Verify that all DO devices operate properly and that the normal positions are correct.
.6 Verify the system sequences of operation. Simulate all modes of operation.
.7 Verify the stability of all DDC loops and optimum start/stop routines.
.8 Check each alarm separately.
.9 Verify interlocks and conditional control response.
.10 Simulate alarm conditions to check the initiating value of variable and interlock action.

.3 The contractor shall complete and submit System Startup Verification Forms. Each BAS device/component shall be included on the verification forms and each item shall be signed

1.9 SYSTEM STARTUP VERIFICATION TESTING (Cont'd)

.3 (Cont'd)
off as verified (yes), or not verified (no) and actual date of verification.

1.10 EMCS COMMISSIONING

.1 The Contractor shall notify the Departmental Representative at least 7 days in advance of EMCS Commissioning. The EMCS Commissioning shall include the Functional Performance Tests and Control System Demonstration. Test and demonstration period for this project shall be two weeks or longer as required by the. Departmental Representative.

.2 The Contractor shall provide instrumentation and technical personnel equipped with two-way communication to carry out the EMCS Commissioning under the direction of the Departmental Representative. The technical personnel shall be fully aware of and qualified to interpret design criteria and design intent.

.3 The Functional Performance Test Forms shall be completed and signed by the Contractor.

.4 Every point shall be checked end to end to ensure accuracy and integrity of systems. As each control input and output is checked, a log to be completed showing the date and any corrective action taken or needed.

.5 Test each system independently and then in unison with integrated systems. Debug systems and fine tune operation and performance of each system.

.6 Demonstrate the following:
.1 Calibration, response, and action of every point and system.
.2 Actual field operation of each control and sensing point for all modes of operation.
.3 Compliance with system performance.
.4 The operation of each system including sequence of operations in regular and emergency modes, under all normal and emergency conditions, startup, shutdown, interlocks, and lock-outs.
.5 Complete operation of all operator interfaces including modem operation and remote operator workstations. Submit printout of the DDC controller programs including point definitions, weekly and annual schedule setting,

1.10 EMCS COMMISSIONING (Cont'd)

.6 Demonstrate the following:(Cont'd)
.5 (Cont'd)
DDC controller setpoints and tuning parameters, documented programmed sequence of operation.
.6 DDC loop response with trend data output in a graphical form. Provide trend log and correspondence setpoint for at least 24 hours and sample frequency of every 60 seconds to prove stability of loop.
.7 Optimum start/stop with trend data output showing the capability of the algorithm.
.8 The operational logs for each system that indicate all set points, operating points, valve positions, for not less than 48 hours periods and have a sample frequency of every 60 minutes.
.9 Trend log of each A1 points for at least one week with sample frequency of every hour. Provide printed graphs of trend logs.
.10 Runtime totalization for all assigned DI and DO points.
.11 Analog/pulse totalization for assigned AI or pulse input points.
.12 The interface to the building fire alarm system.
.13 The system recovery with a simulated power failure.

.7 Operational logs, trend logs, DDC control loop plot, and reports shall be submitted in both printed and disk formats for review by the Departmental Representative.

.8 Upon completion of commissioning to the satisfaction of the Departmental Representative, set and lock all devices in final position, and permanently mark all settings.

.9 Refer to Section 01 91 00 for additional requirements.

1.11 OPERATION AND MAINTENANCE MANUAL

.1 The manual shall be custom designed for this project and contain only information relevant to this project.

.2 One complete set of manuals shall be furnished prior to the time that system or equipment tests are performed, and the remaining manuals shall be furnished at acceptance. The manual shall provide full and complete coverage of the following subjects:
.1 Operational Requirements: This document shall describe, in concise English terms, all the functional and operational requirements for

1.11 OPERATION AND MAINTENANCE MANUAL (Cont'd)

.2 (Cont'd)

.1 Operational Requirements:(Cont'd) the system and its functions that have been implemented.

.2 System Operation: Complete step by step procedures for operation of the system, including required actions at each operator station; operation of computer peripherals; input and output formats; and emergency, alarm, and failure recovery. Step-by-step instructions for system startup, back-up equipment operation, and execution of all system functions and operating modes shall be provided.

.3 Maintenance: Documentation of all maintenance procedures for each and all system component including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective module.

.4 Test Procedures and Reports: The test implementation shall be recorded with a description of the test exercise script of events and documented as Test Procedures. A provision for the measurement or observation of results , based on the previously published Test Specification, forms the Test Reports.

.5 Configuration Control: Documentation of the basic system design and configuration with provisions and procedures for planning, implementing, and recording any hardware or software modifications required during the installation, test, and operating lifetime of the system.

1.12 TRAINING

.1 Provide the services of competent instructors who will provide instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified. The training shall be specific to the system installed rather than being a general "canned" training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The Departmental Representative shall have the right to approve/reject the instructors based on their qualifications. A training manual shall be provided for each trainee which describes in detail the data included in each training program. All equipment and material required for classroom training shall be provided by the Contractor. Classroom training in two phases shall be conducted at control vendor's training facility. The first phase shall be for a period

1.12 TRAINING (Cont'd)

.1 (Cont'd)
of 2 days prior to the completion tests. The second phase shall be for a period of 5 days following commissioning.

.2 At least 30 days prior to commencement of training, submit training program with course outline, agenda and a copy of training manual for review by the Departmental Representative.

1.13 WARRANTY AND MAINTENANCE

.1 The Contractor shall provide all services; materials and equipment necessary for the maintenance of the Automatic Control Systems for a period of 12 months concurrent with the warranty period.

.2 The Contractor shall provide three minor inspections or as required by the manufacturer and one major inspection per year, and all service for the required maintenance. Major inspection shall be scheduled in April or November. A major inspection shall involve a point by point check and/or calibration. Provide dated database log to indicate executed point to point system check.

.3 Emergency Service: The Departmental Representative will initiate service calls when there is indication that the Automatic Control System is not functioning properly. The Contractor shall have qualified personnel available during the contract period to provide service to the "critical" overall control system components whenever required at no additional cost to the owner. The contractor shall furnish the Departmental Representative with a telephone number where the service personnel can be reached at all times. The service technician shall be on the job ready to service the control system within 4 hours after receiving a request for service. The work shall be performed continuously until the control system is back in reliable operating condition. This service shall be provided on a 24 hours basis 7 days a week.

.4 Upon completion of each inspection or emergency service, submit fully detailed report in writing to Departmental Representative.

PART 2 - PRODUCTS

2.1 BAS DATA COMMUNICATION NETWORK

.1 The Control Manufacturer shall design, supply, install and connect a data communication network to link all Terminal Control Units, Local Control Units, Master Control Units, and Operator Workstations as indicated on the BAS Network Architecture.

.2 The data communication network modifications shall include all network components including cables, connectors, repeater, hubs, and routers necessary for connection of new devices to the existing BAS LAN and buses.

.3 EMCS Communication Bus (EMCS-BUS): a local secondary bus or subnetwork that links Local Control Units (LCUs) and Terminal Control Units (TCUs) to a Master Control Unit (MCU). The combined quantity of LCU's and TCUs directly connected to one EMCS-BUS subnetwork shall not exceed 50. Data transmission rate to be 9600 Baud minimum. Acceptable secondary Communication Bus: RS-485 LAN, Lontalk.

.4 Master Control Units (MCUs): Stand-alone fully user programmable DDC Controllers that reside on EMCS-LAN.

.5 Local Control Units (LCUs): Stand-alone fully user programmable DDC Controllers that reside on EMCS-BUS.

.6 Terminal Control Units (TCUs): Stand-alone DDC Controllers that reside on EMCS-BUS. Terminal Control Unit is not fully user-programmable, but is configured with its hardware and firmware to match a specific application.

.7 Dynamic Data Access: all Operator Workstations, either network resident or connected via dial-up modems or gateways, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the network. Access to data shall be based upon logical identification i.e. Building, System, Point.

.8 Network medium: twisted cable, coax cable, or fibre optic cable compatible with the network protocol to be used within buildings, and fibre optic cable to be used between buildings.

2.2 EXISTING OWS

.1 All real-time control functions shall be executed on the appropriate MCUs, LCUs or TCUs, but edited and archived on the existing OWS.

.2 Workstation functinality related to new installed I/O points shall include but not be limited to the following functions:
- .1 Operator's commands and programming.
- .2 Access control.
- .3 Graphics software.
- .4 Alarm management.
- .5 Reports and logs.
- .6 Database back-up and download.

.3 Refer to the specification for additional requirements of each function.

2.3 OPERATOR'S COMMANDS AND PROGRAMMING

.1 Provide capability for non-programmer operator to perform global supervision tasks such as to view, and edit if applicable, the status of any object and property in the system.

.2 Operator shall be able to terminate automatic software control, initiate DO and AO manual commands, and return DO and AO manual commands to automatic software controls.

.3 Provide capability for existing OWS to fully commununicate with and create, edit, and download custom application programs to support new MCUs and LCUs added to network. On-line programming/configuration shall not interfere with normal system operation and control.

2.4 ACCESS CONTROL

.1 Existing Operator access levels and capabilities, including log-off times, to apply new points and control units installed under this contract.

2.5 GRAPHICS

.1 Modify existing graphics or create new graphics at each existing graphics software. Operators shall be able to start and stop equipment or change set points from graphical displays.

.2 The Contractor shall utilize the existing graphics software to generate the custom Building Outline Drawings, Equipment and Sensors Location Diagrams, and Control Schematic

2.5 GRAPHICS (Cont'd)

.2 (Cont'd)
Diagrams for new points added under this project.

.3 Operator shall be able to build graphic displays using a library of pre-engineered screens and symbols depciting standard mechanical system components that include on-line point data from multiple MCU panels. Data shall be updated every 10 seconds or less.

.4 Dynamic data display: dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to show current values without operator intervention.

2.6 ALARM MANAGEMENT

.1 Add new alarm points specified in the sequence of operation to OWS displays and graphics to notify the operator of the occurrence of an alarm condition. All alarm messages shall be displayed and printed. Alarm messages shall include as a minimum: location of alarm, time of occurrence, and type of alarm. Each point shall have its own message. Assignment of messages to a point shall be an operator editable function.

.2 System Reaction to Alarms: Alarm annunciation shall be via dedicated alarm window plus audible tone (as determined by alarm type) to operator that an alarm condition exists. Acknowledgement of alarm will change the visual indicator from flashing to steady state and will silence the audible. Acknowledgement of alarm shall be logged on OWS printer with operator's name and time.

.3 All new alarms shall be classified and identified as "critical" or "cautionary" or "maintenance". The system shall notify the operator of the occurrence of EMCS alarms within the following time period of any alarms being detected by the EMCS:

.1 Critical - 2 seconds.
.2 Cautionary - 8 seconds.
.3 Maintenance - Upon operator's request.

2.7 REPORTS AND LOGS

.1 Add new BAS points and devices to all existing special reports or newly required (e.g. trend logs) described below. These include reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at the MCU level. Create new reports for areas and buildings wehre required to aliign with special reports already existing in other areas and buildings.

.2 All reports shall include time, day, month, year, report title, and operator's initials. Dynamic and summary reports shall be generated automatically or manually, and directed to either displays, printers, or storage.

.3 Dynamic reports: printout or display of any dynamic value requested by operator. Indicate point name, scan rata and output device. Reports shall be available for specific points, a logical point group (by system and/or point type), a user-selected group of groups.

.4 Summary reports: printout or display of any database value selected by operator. Periodic/automatic summary reports shall include power demand and duty cycle, disabled "locked-out" points, run time total, ren time alarms, start/stop schedules, motor status.

.5 Data logging and recall. Data collection to be continuous and stored in temporary storage of MCU until point is removed from collection program by the operator. Provide software to automatically dump the temporary report storage to the hard disk drive of the OWS on a periodic 24 hour basis minimum or when temporary storage is filled. Inform operator when dump has occurred.

.6 Trend logs: Points at each new Control Unit to be concurrently trended at an operator selectable rate of 5 seconds to 3600 seconds individually selected for each point. Permit display trend plots on OWS and plot up to 4 selectable points concurrently.

.7 Alarm and Event Log: the operator shall be able to view system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the

2.7 REPORTS AND LOGS (Cont'd)

.7 Alarm and Event Log:(Cont'd)
operator shall be archived to the hard disk on the workstation.

2.8 DATABASE BACK-UP AND DOWNLOAD

.1 Back-up copies of all MCU panel databases shall be stored in at least one Operator Workstation. Continuous supervision of the integrity of all MCU panel data bases shall be provided. In the event that any MCU panel on the network experiences a loss of its data base for any reason, the system shall activate alarm. Operator shall have the ability to manually execute downloads of any or all portions of a MCU panels data base.

2.9 MASTER CONTROL UNITS (MCU)

.1 The Master Control Unit (MCU) is to be a stand-alone DDC controller with the following characteristics:
.1 MCU shall be micro processor based, multi-tasking, multi-user, real-time digital control processors capable of supervising other lower level programmable control units through a secondary network. Each MCU shall consist of modular hardware with plug-in processors, communication controllers, power supplies, and input/output modules.
.2 Each MCU shall provide at least two data communication ports for PC computer, modem and/or printer connection. MCU shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or Operator's Terminals.
.3 The Processor shall execute programmable logic control (Direct Digital or Closed Loop Process Control) of associated HVAC equipment without interacting with any other Processor or Operator Workstation.
.4 Basic functional requirements to include scanning of digital/analog input, digital change of state (alarm) monitoring, analog input (alarm) monitoring, on-off digital control with programmable logic, analog control using programmable logic (including PID) with adjustable dead bands and deviation alarms, control of HVAC systems, as specified under sequence of operation instructions.
.5 Provide connection to existing LAN and establish communication between all new MCUs and the existing operator workstation located in Building WW19. The communications protocol used

2.9 MASTER CONTROL UNITS (MCU) (Cont'd)

.1 (Cont'd)

.5 (Cont'd)

by the MCU shall be compatible with that used by existing devices connected to the BAS LAN. The preferred communication protocol is native BACnet.

.2 Each MCU shall have sufficient capacity for its assigned D1, D0, A1, A0 points as indicated on the DDC Input/Output Point Schedules. Unless noted on the Input/Output Point Schedule or approved by the Departmental Representative, all points associated with one mechanical system shall be connected directly to the same MCU.

.3 Unless noted or approved by the Departmental Representative, provide a minimum of one Master Control Unit (MCU)for each mechanical room.

.4 Minimum addressable memory shall be sufficient to support all performance and technical specifications. All operating system, executive, application, subroutines, and other configuration definition software, shall reside in non-volatile memory such as EPROM. All control description logic, application functions and operating data or software shall reside in battery backed RAM 72 hours or EPROM and hence modifiable on-line through the operator panel or remote operators interface. Complete Ram Memory must be downline loadable from Operator Workstations.

.5 Include an uninterruptible clock, with an accuracy of ±5 seconds per month and capable of deriving month/day/hour/min./seconds. Rechargeable batteries to provide a minimum of 72 hours of operation in the case of power failure.

.6 Integrated on-line diagnostics: each MCU panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The MCUs shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Diagnostic LEDs for power, communication and processor shall be provided at each MCU.

.7 Surge and transient protection: isolation shall be provided at all network terminations, as well as all field point termination to suppress inducted voltage transients consistent with IEEE Standard 587.

2.9 MASTER CONTROL UNITS (MCU) (Cont'd)

.8 Electrical noise protection: operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m.

.9 Unless noted otherwise, MCUs shall be used to directly control all major mechanical equipment including chiller systems, boiler systems and built-up air handling units.

2.10 MCU SOFTWARE

.1 The software programs specified shall be provided as an integral part of the Master Control Units and shall not be dependent upon any higher level computer for execution. Software shall include but not be limited to operating systems executive, control description logic, energy management and totalization. The MCU software shall also support the operator interface functions specified in OWS software.

.2 Programming:

.1 Control description logic shall be written in general control type or high level language. The operator shall, at his discretion, be able to alter the operating parameters on-line from the MCU or OWS to tune a control loop.

.2 Any change to the program shall be performed on-line.

.3 Control description logic will have access to values or status of all points available to the controller including global or common values, allowing cascading and interlocking control.

.4 The MCU shall have the ability to perform the following pre-tested control algorithms:

.1 Two Position Control.

.2 Proportional Control.

.3 Proportional plus Integral Control.

.4 PID Control.

.5 Automatic Control Loop Tuning.

.5 Equipment cycling protection: control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.

.6 Heavy equipment delays: the system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads. Motors of 15 kW and larger shall be included in the program.

.7 Fire shut-down: with the exception of stair pressurization fans or smoke exhaust fans, all other fans under the control of EMCS shall

2.10 MCU SOFTWARE (Cont'd)

.2 Programming:(Cont'd)

.7 Fire shut-down:(Cont'd)
shut-down when a fire alarm signal is received by the EMCS.

.8 Power fail shut-down: in the even of the loss of normal power, there shall be an orderly shutdown of all MCUs to prevent the loss of database or operating system software.

.9 Automatic restart: upon the resumption of normal power, as determined by the emergency power transfer switches or fire alarm panel, the automatic restart program shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

.3 MCU panels shall have the ability to perform any or all of the following energy management routines:

.1 Auto Start/Stop Scheduling.
.2 Optimal Start/stop.
.3 Temperature Reset.
.4 Economizer Control.
.5 Peak Demand Limiting.

.4 Totalization:

.1 Runtime totalization: MCU panels shall automatically accumulate and store runtime hours for binary input and output points.

.2 Analog/pulse totalization: MCU panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

.3 Event totalization: MCU panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

2.11 LOCAL CONTROL UNITS (LCU)

.1 The Local Control Unit is to be a standalone DDC controller with the following characteristics:

.1 LCU shall incorporate a programmable microprocessor, non-volatile program memory, random access memory, power supplies and appropriate communication interfaces as required to perform specified functions.

.2 LCU shall incorporate a communication interface port for communication to a Master Control Unit (MCU) or other device residing on the existing BAS LAN. Establish communiation

2.11 LOCAL CONTROL UNITS (LCU) (Cont'd)

.1 (Cont'd)

.2 (Cont'd)

between all new LCUs and those existing or new MCUs(or other network devices) residing on the existing LAN. The communication protocol used by the LCU shall be compatible with all new or existing MCUs or other network devices that they communicate through. Inputs/outputs associated with each LCU shall thereby be accessible via the OWS located in Building WW19.

.3 LCU shall execute it's logic and control (Direct Digital or Closed Loop Process Control) of associated equipment without interacting with any other Processor.

.4 Basic functional requirements to include scanning of digital/analog inputs, digital change of state (alarm) monitoring, analog input (alarm) monitoring, on-off digital control with configurable logic, analog control using configurable logic (including PID) with adjustable dead bands and deviation alarms, control of HVAC systems, specified under sequence of operation instructions.

.2 Minimum addressable memory shall be sufficient to support all performance and technical specifications. All operating system, executive, application, subroutine, and other configuration definition software, shall reside in non-volatile memory such as EPROM. All control description logic, applicable functions and operating data shall reside in battery backed RAM 72 hours or EEPROM and hence modifiable on-line through the operator panel or remote operator interface. All operating data must be downline loadable from Operator Workstations.

.3 Each LCU shall have sufficient capacity for its assigned DI, DO, AI, AO points as indicated on the DDC Input/Output Point Schedules. Unless noted on the Input/Output Point Schedule or approved by the Departmental Representative, all points associated with one mechanical system shall be connected directly to the same LCU.

.4 The LCU shall include as a minimum 2 interface ports for connection of MCU controller and local computer terminal.

.5 In the event of loss of communications with, or failure of the MCU, this controller shall continue to perform control of the associated equipment. Controllers that use defaults or fail to open or closed position will not be acceptable.

2.11 LOCAL CONTROL UNITS (LCU) (Cont'd)

.6 Unless noted otherwise, LCUs shall not be used to control any major mechanical equipment. LCUs shall be used to control packaged and distributed equipment such as packaged air handling units, radiation, and exhaust fans, and multi-zone VAV boxes.

2.12 LCU SOFTWARE

.1 Software shall include but not be limited to definitions and operating systems executive, communications, control description logic, operator interface.

.2 Control description logic shall be written in general control type or high level language.

.3 Control description logic shall have access to values or status of all points available to the controller including global or common values, allowing cascading and interlocking control.

.4 Software to be generic and configurable from computer terminal or to be downloaded from operator workstations.

2.13 TERMINAL CONTROL UNITS (TCU)

.1 Each Terminal Control Unit (TCU) is to be a microprocessor-based standalone DDC controller with the following characteristics:
.1 Hardware and firmware are configured to control a specific type of terminal equipment such as conventional single zone VAV box or fan powered VAV box.
.2 The controller shall incorporate a communication interface port for communication to a Master Control Unit (MCU) or other device residing on the existing BAS LAN. Establish communication between all new LCUs and those existing or new MCUs (or other network devices) residing on the existing LAN. The communication protocol used by the TCU shall be compatible with all new or existing MCUs or other network devices that they communicate through.
.3 Each TCU shall have sufficient capacity and memory to support its operating system, data bases and specified functional requirements under sequence of operation instructions.

.2 Each TCU shall support multiple modes of operation including Day/Weekly Schedules, Occupied/Unoccupied Mode, and Override Mode.

2.13 TERMINAL CONTROL UNITS (TCU) (Cont'd)

.3 The existing Operator Workstation (OWS) connected to the communication network in Building WW19 shall be able to access all information including sensor values, operating status, setpoints, on/off schedules, alarm limits and other operating parameters of each TCU. Operator at OWS connected to the network shall be able to make setpoint adjustments, assign high and low alarm limits and make programming changes.

.4 Powerfail Protection: all system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration will not require reprogramming the DDC controller.

2.14 TEMPERATURE SENSORS AND TRANSMITTERS

.1 General: temperature sensors shall be RTD platinum type, unless otherwise noted.

.2 Temperature sensors shall be of the following types.

.1 Space RTD - suitable for wall mounting, with protective guard.

.2 Duct point RTD - suitable for insertion into air ducts at any angle, insertion length of 460 mm unless otherwise as noted on schedule or drawings.

.3 Immersion RTD - Spring loaded construction with compression fitting for 20 mm NPT well mounting. Lengths of 100 mm or 150 mm unless otherwise noted.

.4 Mixed Air Averaging RTD: continuous filament with probe length of 6000 mm minimum. Maximum 6 m^2 cross section area per sensor. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance.

.5 Outdoor RTD: complete with noncorroding shield designed to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, probe length of 100-150 mm.

.3 Provide each sensor with a temperature transmitter having the following minimum specifications:

.1 Output signal of 4-20 mA into maximum of 500 ohm load.

.2 Combined nonlinearity, repeatability and hysteresis effects not to exceed ±0.5% of full scale output.

.3 Integral, zero and span adjustments.

2.14 TEMPERATURE SENSORS AND TRANSMITTERS (Cont'd)

.3 (Cont'd)
.4 Temperature effect of ±1.0% full scale or less.

.4 Range of sensors to suit application and to be submitted with shop drawings.

2.15 HUMIDITY SENSORS AND TRANSMITTERS

.1 Provide humidity sensors with the following minimum specifications:
.1 Operating range: 10-90% RH.
.2 Operating temperature: 0°C to 60°C.
.3 Accuracy: ±2% RH at 25°C.
.4 Response time: 60 seconds from 90% to 10% RH.

.2 Provide transmitters for all supplied relative humidity sensors with the following minimum specifications:
.1 Output signal of 4-20 mA or 0 to 10 VDC.
.2 Maximum output linearity error of ±1.0% of full scale output.
.3 Integral zero and span adjustments.
.4 Temperature effect of ±1.0% full scale or less.
.5 Drift: not to exceed 1% over 12 months.

2.16 AIR SYSTEM STATIC PRESSURE SENSORS AND TRANSMITTERS

.1 Sensors shall meet the following:
.1 Multipoint element with self-averaging manifold.
.2 Maximum pressure loss: 160 Pa at 10 m/s. (air stream manifold).
.3 Accuracy: ±1% of actual duct static pressure.

.2 Provide each sensor with a transmitter to meet the following 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: ±1.0% of full scale.
.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 Range: 0 to 125 Pa static pressure downstream of VAV boxes and 0 to 373 Pa static pressure upsteam of VAV boxes, unless otherwise noted.

2.17 AIR SYSTEM VELOCITY SENSOR/ TRANSMITTER

.1 Sensors shall meet the following requirements:
.1 Multipoint static and total pressure sensing element with self-averaging manifold, and with integral air equalizer and straightener section.
.2 Maximum pressure loss: 37 Pa at 10 m/s.
.3 Accuracy: ±1% of actual duct velocity.

.2 Provide each sensor with a transmitter to meet the following requirements:
.1 Output signal: 4 - 20 mA or 0 - 10VDC linear into 500 ohm maximum load.
.2 Calibrated span: not to exceed 25% of duct static pressure at maximum flow.
.3 Accuracy: ±0.4% of span.
.4 Repeatability: within 0.1% of output.
.5 Linearity: within 0.5% of span.
.6 Deadband or hysteresis: 0.1% of span.
.7 External exposed zero and span adjustment.
.8 Air velocity range: 1 m/s to 10 m/s at 15°C.

2.18 PRESSURE/ CURRENT TRANSMITTERS

.1 Provide pressure-to-current transmitters having the following minimum specifications:
.1 Internal materials of the transducer suitable for continuous contact with industrial standard instrument air, compressed air, water or steam as applicable.
.2 Output signal of 4-20 mA into a maximum of 500 ohm load.
.3 Output variations of less than 0.2% full scale for supply voltage variations of ±10%.
.4 Combined nonlinearity, repeatability and hysteresis effects not to exceed ±0.5% of full scale output over entire range.
.5 Integral zero and span adjustment.
.6 Temperature effect of ±1.5% full scale/50°C or less.
.7 Output short circuit and open circuit protection.
.8 Over-pressure input protection to a minimum of twice rated input.
.9 Pressure ranges to suit application.

2.19 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Provide differential pressure transmitters having the following minimum specifications:
.1 Internal materials to be suitable for continuous contact with the process material measured including compressed air, water, glycol, or steam as applicable.

2.19 DIFFERENTIAL PRESSURE TRANSMITTERS (Cont'd)

.1 (Cont'd)
.2 Output signal of 4-20 mA into maximum of 500 ohm load.
.3 Output variation of less than 0.2% full scale for supply voltage variations of ±10%.
.4 Combined nonlinearity repeatability and hysteresis effects not to exceed ±0.5% of full scale output over entire range.
.5 External exposed integral zero and span adjustment.
.6 Temperature effect of ±1.5% full scale/50°C or less.
.7 Output short circuit and open circuit protection.
.8 Over-pressure input protection to a minimum of twice rated input.
.9 Differential Pressure ranges to suit application.

2.20 PRESSURE SWITCHES

.1 Provide pressure or differential pressure switches for ranges as indicated on point schedule.

.2 Pressure sensing elements shall be bourdon tube, bellows or diaphragm type.

.3 Adjustable setpoint and differential.

.4 Pressure switches shall be snap action type rated at 120 volts, 15 amps AC or 24 volts DC.

.5 Sensor assembly shall operate automatically and reset automatically when condition returns to normal.

2.21 TEMPERATURE SWITCHES

.1 Provide High/Low temperature switches for ranges as indicated on point schedule.

.2 Temperature sensing element shall be liquid, vapour or bimetallic type.

.3 Adjustable setpoint and differential.

.4 Snap action type rated at 120 Volts, 15 amps or 24 V DC as required.

.5 Sensors shall operate automatically and reset automatically. Sensors used for freeze detection or fire detection shall be manually reset type.

2.21 TEMPERATURE SWITCHES (Cont'd)

.6 Temperature switches shall be of the following types:
.1 General Purpose Duct type - suitable for insertion into air ducts, insertion length of 457 mm.
.2 Thermowell type - with compression fitting for 20 mm NPT well mounting, length of 100 mm. Immersion wells shall be stainless steel.
.3 Freeze detection type - continuous element with insertion length of 6000 mm minimum, suitable for duct mounting to detect the coldest temperature in any 30 mm section.

.7 Temperature accuracy shall be ±1°C.

2.22 CURRENT/ PNEUMATIC TRANSDUCERS

.1 Provide current to pneumatic transducers having the following minimum specifications:
.1 Input range of 4-20 mA or 0 to 10 VDC as suitable for interfacing with the FID digital-to-analog converter output subsystem.
.2 Directly proportioned output range of 20-104 kPa.
.3 Dustproof housing or panel mounted.
.4 Internal materials of the converter suitable for continuous contact with industrial standard instrument air.
.5 Combined nonlinearity, repeatability and hysteresis effects not to exceed +2% of full scale over the entire range.
.6 Integral zero and span adjustment.
.7 Temperature effect of +2.0% full scale or less.
.8 Maximum regulated supply pressure of 138 kPa or less.
.9 Provide air gauge on outlet.
.10 Air consumption: 0.008 scfm at 103 KPa supply.

2.23 CONTROL RELAYS

.1 Contacts rated at 5 amps at 120 V AC.

.2 Relays to be plug in type with termination base.

2.24 CURRENT TRANSDUCER

.1 Provide current transducers with range to match load being metered.

2.24 CURRENT TRANSDUCER (Cont'd)

.2 Current transducers shall measure line current and produce a proportional signal in one of the following ranges.
.1 4-20 mA dc.
.2 0-1 V dc.
.3 0-10 V dc.
.4 0-20 V dc.

2.25 CURRENT SENSING RELAY

.1 Provide adjustable current-operated solid-state relays with integral zero leakage LED for switching AC or DC circuits.

.2 The contacts shall close when the current level sensed by the internal current transformer exceeds the trip point set by the multi-turn adjustment.

.3 Range of monitored AC current to suit application and to be submitted with shop drawings.

2.26 CONTROL DAMPERS

.1 Construction: Blades shall not exceed 200 mm wide or 1250 mm long. Modular maximum size 1250 mm wide x 1500 mm high. Multiple sections to have stiffening mullions and jack shafts.

.2 Materials:
.1 Frame: 2.3 mm (13 gauge) galvanized sheet steel.
.2 Blades: two sheets 0.5 mm (22 gauge) or 1.6 mm (16 gauge) galvanized steel.
.3 Bearings: oil impregnated sintered bronze. Provide additional thrust bearings for vertical blades.
.4 Linkage and shafts: zinc plated steel.
.5 Seals: Replaceable neoprene seals or stain-less steel spring on sides, top and bottom of frame and along all blade edges and blade ends.

.3 Performance:
.1 50 L/s/m2 maximum allowable leakage against 1000 Pa static pressure.
.2 Temperature range: minus 50°C to 100°C.

2.27 DAMPER OPERATORS ELECTRONIC

.1 Provide direct coupled type electronic proportional damper operators where indicted or required.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position where required.

.3 Size operators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.

.4 For modulating services, provide feedback circuit to indicate actuator position.

.5 Power Requirements 12 VA maximum at 24 V AC.

.6 Input signal: 2 to 10 VDC or 4 to 20 mA.

2.28 CONTROL VALVES

.1 Provide control valves as shown on drawings or listed on valve schedule.

.2 Valves 50 mm and smaller to be bronze with screw end connections. Valve 62 mm and larger to be cast iron with flanged end connections.

.3 All trim to be 316 SST.

.4 Valves to provide tight shut-off. Maximum leakage of 0.5% of rated flow.

.5 Valves to be Normally Open, Normally Closed 2 or 3- way as shown.

.6 Valves to have linear or equal percentage flow characteristics as indicated.

.7 Rangeability of valves to be minimum 50:1.

.8 Sizing Criteria:
.1 Two-position service: Line size.
.2 Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa, whichever is greater.
.3 Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa maximum.

2.29 ELECTRONIC VALVE ACTUATORS

.1 Provide Electronic Valve Proportional Actuators with spring return to normal positions indicated.

.2 Construction to be steel , cast iron or cast aluminum.

.3 For modulating services, provide feedback circuit to indicate actuator position.

.4 Control Voltage 0-20 V DC or 24 V AC.

.5 Positioning time - nominal 60 seconds.

2.30 ELECTRONIC RADIATION OR TERMINAL REHEAT CONTROL VALVE

.1 Provide small electronic control valve of size 15 mm or 20 mm as indicated on drawing.

.2 Valves shall be bronze with screw end connections. Stainless steel trim.

.3 Valves to have linear or equal percentage flow characteristics.

.4 Rangeability of size 15 mm valves to be 50:1 and 20 mm valves to be 100:1.

.5 Running time at 60 Hz to be 125 seconds.

.6 Control voltage: 24 VAC, floating two position control signal to control the valve.

2.31 ROUND ZONE CONTROL DAMPERS

.1 Provide round zone control dampers on the ducts to the individual air outlets for the multi-zone VAV boxes as shown on the drawings.

.2 Damper shall be of the butterfly type consisting of circular blade mounted to a shaft. Inside frame surface shall be clean and smooth with no blade stops or similar inward projects.

.3 Frames shall include rolled stiffener beads to allow easy sealing of spiral ductwork joints. Damper frame and blade shall be fabricated from 1.6 mm galvanized steel.

.4 Sizing Criteria: Velocity shall not be less than 4.6 m/s at design airflow.

2.32 TWO POSITION ELECTRONIC ACTUATORS

.1 Use of two position actuators shall be limited to radiation control valves in Building WW03.

.2 Provide two position outputs from DDC controllers (binary outputs) for control of radiant actuators.

2.33 PNEUMATIC TUBING

.1 Pneumatic tubing: use copper tubing type L with flared fittings unless otherwise specified.

2.34 EXISTING CONTROLS

.1 Unless noted otherwise or approved by the Departmental Representative in writing, all control devices required for a complete and working EMCS System shall be new and shall be provided by the Contractor.

.2 Any existing control dampers, control valves, sensors and end devices that may be reused are noted in the "Comments" column on the DDC Input/Output Point Schedules. If not so identified, assume existing devices are to be replaced. Within 30 days of contract award the Contractor shall test and inspect for satisfactory operation all existing devices which are permitted to be reused. For those items considered nonfiction, the Contractor shall provide with the report, to support the findings, and obtain the Departmental Representative's instruction.

.3 The Contractor shall submit written requests to disconnect any controls and to obtain equipment down time. Only after receiving these requests shall such work be allowed to proceed.

.4 The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of owner equipment, or failure in reporting defective controls within 30 days of contract award.

.5 Shop drawings shall show all signal levels, pressures, etc., where tying into existing control equipment.

.6 Where existing controls are not to be reused or not required, they shall be removed and placed in storage for future disposition as directed by the Departmental Representative.

2.35 CONDUIT AND WIRE

.1 Use type FT6 plenum rated cable for low voltage EMCS wiring in ceiling return plenum. Support FT6 cables in ceiling return plenum using Thomas & Betts TY-RAP cable straps and clamps screwed on to ceiling slab. Spacing to be 2M maximum. Do not use ceiling suspension wires for fastening cables. Exact routings shall suit site conditions and shall be to the approval of the Departmental Representative.

.2 Use EMT conduit for wiring in mechanical, electrical, janitor rooms or equipment rooms.

.3 Unless noted otherwise, install network cable within building in EMT conduit and install network cable between buildings in buried PVC conduit. The control contractor shall provide conduits with spare capacity not less than 50%.

.4 Field wiring for each digital input and output shall be No. 20 AWG, stranded twisted pair. For multi-conductor wire having four or more conductors, wire size shall be not less than No. 22 AWG solid copper. Analog input hall be wired with shielded No. 20 AWG, stranded twisted pair, copper wire. Analog output shall be wired with 3 shielded No. 20 AWG stranded twisted copper wires.

.5 Where conduits pass through fire rated walls or floors, provide schedule 40 steel sleeves filled with fire stopping material and approved sealant around conduits to maintain fire rating integrity.

2.36 RESPONSIBILITY FOR QUANTITIES

.1 Failure to carry the correct lengths or sizes of conduit or correct types of wire or the correct number of DDC panels is the contractor's responsibility and shall not be basis for additional charges by the contractor.

2.37 WIRING IDENTIFICATION

.1 Provide numbered tape markings on all branch control wiring, and pneumatic tubing.

.2 At all junction boxes, splitters, cabinets and outlet boxes, maintain identification system.

.3 Use colour coded wires in communication cables, matched throughout system.

2.37 WIRING IDENTIFICATION (Cont'd)

.4 Identify all power sources at each panel location.

2.38 CONDUIT IDENTIFICATION

.1 Colour code all Control System conduits.

.2 Coding to be located on all conduits and cables exposed after completion of construction in all locations including suspended accessible ceilings, tunnels and shafts.

.3 Coding to be plastic tape or paint at all points where conduit or cable enters wall, ceiling, or floor, and at 15000 mm intervals.

.4 Coding to be 25 mm wide, and fluorescent orange. Colour to be confirmed by the Contractor with the Departmental Representative at commencement of the project.

2.39 MANUFACTURER'S AND CSA LABELS

.1 Manufacturers' nameplates and CSA labels to be visible and legible after equipment is installed.

PART 3 - EXECUTION

3.1 GENERAL

.1 All equipment shall be installed according to manufacturers' published instructions.

.2 Provide programming for the system and adhere to the sequence of operation specified.

3.2 BUILDING AUTOMATION SYSTEM (BAS) NETWORK ARCHITECTURE

.1 Provide a Building Automation System (BAS) Network Architecture drawing which illustrates the delineaton of new devices installed under this Section from existing control devises.

3.3 DDC INPUT/ OUTPUT POINT SCHEDULE

.1 DDC Input/Output Point Schedule is appended to this Section.

.2 Naming convention: PWGSC Standardized Identifiers and Expansions of Building Names, System Names and Point Names shall be used for

3.3 DDC INPUT/ OUTPUT POINT SCHEDULE (Cont'd)

.2 Naming convention:(Cont'd) identification. Identifiers shall be not more than 10 alphanumeric characters, and Expansions shall not more than 40 characters.

.3 The Application Programs shall be assigned with the specified DDC points as indicated on the DDC Input/Output Schedule. In addition, the Application Program shall be assigned with the following point types:
.1 Alarm Program with: all space temperature AI points, all supply air temperature AI points, all supply air and return air humidity AI points, all air filter pressure drop AI points, all supply air static pressure AI points, all AI points of heating water supply and return temperature, all AI points of chilled water supply and return temperature, all DI points of fans and pumps.
.2 Auto Start/Stop Program with: all DO points of fans and pumps.
.3 Run Time Total Program with: all DO points.
.4 Heavy Equipment Delay Program with: all DO points of motors of 15 kw and larger.
.5 PID Control Program with: all AO points of control valves (except terminal heating control valves and radiation control valves) and control dampers (except terminal zone control dampers).
.6 Analog/PI Total Program with all AI or PI points of water meters and energy meters.

.4 All DI or DO points assigned with "alarm" and "run time total" programs shall be provided with "critical" and "maintenance" alarms. All AI or AO points assigned with "alarm" program shall be provided with "critical" and "cautionary" alarms.

3.4 INSTALLATION OF SENSORS

.1 Install sensors in accordance with the manufacturer's recommendations.

.2 Sensors used in mixing plenums shall be the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

.3 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m^2 of cross section area.

3.4 INSTALLATION OF SENSORS (Cont'd)

.4 All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

.5 Outdoor air temperature sensors shall be installed on north wall, complete with sun shield at designated location.

.6 Building static pressure sensors: Pipe the low pressure port of the differential air static pressure sensor to the static pressure port located on the outside of the building through a high volume accumulator. Pipe the high pressure port to a location behind a thermostat cover.

.7 Supply duct static pressure sensor: Pipe the high pressure tap of the differential air static pressure sensor to the duct using a pitot tube. Pipe the low pressure port to a tee in the high pressure tap tubing of the corresponding building static pressure sensor.

3.5 INSTALLATION OF ACTUATORS

.1 Install actuators in accordance with the manufacturer's recommendations.

.2 Electronic dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.

.3 Electronic Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.6 SEQUENCE OF OPERATION FOR AIR HANDLING UNIT AH1

.1 Modulate heating valve controlling Security Post wall fin heaters to maintain an operator-adjustable space temperature setpoint, initially set to 21 C.

.2 If the wall fin heaters are unable to maintain the space temperature, enable AC1 to operate and provide back-up or standby heat.

.3 If the space temperature falls outside operator-adjustable range, an alarm shall be

3.6 SEQUENCE OF OPERATION FOR AIR HANDLING UNIT AH1 (Cont'd)

.3 (Cont'd)
activated at the existing Operator Workstation (OWS).

.4 MAU-1 provides tempered air to the Security Post The BACS monitors the status of MAU-1 and the discharge temperature off the unit.

.5 If the unit is sensed as being off for more than an operator-selectable period of time, initially set at 35 minutes, an alarm is generated at the OWS. If the discharge temperature drops below 10oC for more than a preset period of time, an alarm is generated at the OWS. (Note: alarm delay to be determined by this Section based on the amount of time it takes for heating coil to come up to temperature when outdoor temperature is below freezing).

3.7 SEQUENCE OF OPERATION FOR ADMINISTRATION BUILDING-ERV DAMPERS AND DUCT HEATING COILS

.1 on receipt of a signal that the ERV is on, open the inlet and exhaust dampers (MD-1 and MD-2).

.2 The BACS monitors the status (open/closed)of MD-1 and MD-2. If a damper that is commanded to be open is sensed as being closed,an alarm shall be activated at the OWS.

.3 Modulate the Energy Recovery Ventilator (ERV-1) preheat valve to maintain entering air temperature to the unit at -9C.

.4 Modulate the Energy Recovery Ventilator (ERV-1) reheat valve to maintain the leaving (supply) air temperature at an operator-adjustable temperature, initially set at 20C.

.5 If the inlet, exhaust or supply air temperature falls outside an operator-adjustable upper and lower limit for more than an operator-adjustable period of time, initially set at 5 minutes, an alarm shall be activated at the OWS.

3.8 SEQUENCE OF OPERATION FOR HOT WATER HEATING SYSTEM IN THE ADMINISTRATION BUILDING

.1 Operate heating pumps in a lead/lag fashion with the lead pump assignment changing weekly to provide equal pump duty. Providing the Hand-Off-Auto selector switches on the pump control panels are in 'Auto' mode, the lead pump will start automatically if the lag pump fails

.2 If the switches are placed in `Hand' position, the pumps run independently of the BACS. If left

3.8 SEQUENCE OF OPERATION FOR HOT WATER HEATING SYSTEM IN THE ADMINISTRATION BUILDING (Cont'd)

.2 (Cont'd)
in `Hand' for more than an operator-adjustable period of time, initially set at 30 minutes, an alarm is generated at the OWS.

.3 The pumps will be disabled when the outdoor temperature rises above an operator-adjustable set point, initially set at 18C.

.4 During inactive periods, each pump will be exercised (separately) for a period of five minutes, once per week.

.5 If a pump that is commanded to be on is sensed as being off, an alarm shall be generated at the OWS.

.6 If the leaving water temperature of an active boiler falls below an operator-selectable value for more than ten minutes, an alarm shall be generated at the OWS.

.7 The hot water by pass valve is normally closed. The valve shall be opened and modulated based on the measured pressure differential between the hot water supply and return lines. The valve shall open at an initial set differential value of 48 Kpa or higher. The set point shall be field adjusted based on approved pump details. The set point shall also be adjustable at the OWS. OWS.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA-C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.
.2 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

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

.3 The Ontario Electrical Safety Code 2009, and all bulletins (Ontario).

.4 Electrical Safety Authority (ESA) requirements and local applicable codes and regulations.

.5 CAN/CSA-C22.2 No.47-M90(R2001), Air-Cooled Transformers (Dry Type).

.6 CSA C9-M1981(R2001), Dry-Type Transformers.

1.2 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.2 Product Data: submit WHMIS MSDS.

.3 Shop drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

1.3 SUBMITTALS (Cont'd)

.3 Shop drawings:(Cont'd)
.2 Submit 6 number of copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.
.3 If changes are required, notify Departmental Representative of these changes before they are made.

.4 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 authority having jurisdiction 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 Electrical Safety Authority having jurisdiction upon completion of Work to Departmental Representative.

1.4 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 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 the requirements of the Departmental Representative.

1.5 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.

1.6 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

PART 2 - PRODUCTS

2.1 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 before delivery to site and submit such approval as described in PART 1 - Submittals.

2.2 WARNING SIGNS

.1 Warning signs: in accordance with requirements of authority having jurisdiction.

.2 Porcelain enamel signs: minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:
.1 Nameplates: plastic laminate 3 mm thick plastic engraving sheet, matt white finish face, black core, mechanically attached with self tapping screws.
.2 Sizes as follows:

2.4 EQUIPMENT IDENTIFICATION (Cont'd)

.1 (Cont'd)

.2 Sizes as follows:(Cont'd)

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No." as directed by Departmental Representative.

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA-C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
T elephone	Green	
Other Communication	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor distribution enclosures light gray.

2.8 DISTRIBUTION SYSTEM

.1 600V, 3 phase, 4W, 60 Hz and 120/208V, 3 phase, 4W, 60 Hz.

.2 Inform other Divisions of electrical system characteristics.

2.9 WIRING SYSTEM

.1 Power and lighting circuits in EMT with drawn-in conductors.

.2 Use heavy wall rigid conduit where required by codes.

.3 RW-90, XLPE insulated wire for panel feeder and branch circuits, GTF insulated wire for final fixture connection.

.4 #12 AWG minimum wire size, #10 AWG or larger shall be stranded.

2.9 WIRING SYSTEM (Cont'd)

.5 Copper conductors.

.6 Size branch circuits and panel feeders for maximum 2% voltage drop.

.7 Provide insulated green ground conductor in EMT conduits.

.8 Provide nylon insulated bushings on the ends of all conduits in junction boxes, pullboxes, panelboards, etc.

.9 Minimum size conduit for lighting and power circuits is 21 mm.

2.10 GROUNDING

.1 Ground service entrance and equipment with approved conductors and connectors.

.2 Make tests required by code and authorities having jurisdiction.

2.11 OUTLET BOXES

.1 Light fixture outlet boxes: standard, octagonal or square as required.

.2 Switch outlet boxes: standard, single or ganged as required.

.3 Receptacle outlet boxes: standard.

.4 Steel construction.

.5 Masonry type in masonry construction.

.6 Standard FS conduit fittings for surface mounted outlets in exposed areas.

2.12 SWITCHES

.1 Specification grade, toggle type, 20 amps, 347 volts, back and side wired, chrome plated yoke, silver cadmium oxide contacts, switch mechanism on neoprene cushion.

.2 Locate switches on latch side of door, 1.4 m above finished floor unless noted otherwise.

2.13 COVER PLATES

.1 Common cover plate at ganged outlet boxes. Split plates not allowed.

2.14 FIXTURE MOUNTING

.1 Provide mounting and supports required for safe installation to Departmental Representative's satisfaction.

2.15 LIGHTING FIXTURES

.1 Provide lighting fixtures with lamps as indicated inLuminaire schedule.

.2 Shop drawings to consist of catalogue cuts and photometric data from an independent test lab.

2.16 FLUORESCENT FIXTURES

.1 Ballast: high power factor, energy saving type automatic resetting, thermal protection, pressure sensitive capacitor protection, lowest sound level available.

.2 Body: minimum 0.952 mm thick (20 gauge) steel, white baked enamel finish, reflectance value minimum 85%.

.3 Lens: 100% pure acrylic, low brightness, sparkling crystal prismatic pattern, maximum efficiency, and direct glare control. ULC certified.

.4 CSA rated for continuous row mounting.

2.17 LAMPS

.1 Fluorescent lamps: 1220 mm length unless specified otherwise, bi-pin, rapid start, premium grade, 18,000 hour life expectancy, 3,200 initial lumen output, cool/warm white.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA-C22.1 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 MOUNTING

.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: 1400 mm.

3.4 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, 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 11 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 Insulation resistance testing:

3.4 FIELD QUALITY CONTROL (Cont'd)

.2 (Cont'd)

.4 Insulation resistance testing:(Cont'd)

.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.

3.5 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