Specifications for
Buoy Maintenance Building
2021 HVAC upgrades

Canadian Coast Guard – Victoria Base

Issued for: Tender
Project No.: 20210346
Date: August 11, 2021

Part 1 General

1.1 PROFESSIONAL SEALS

Discipline	Responsibility	Seal
Mechanical	Divisions: 00, 01, 02, 13, 23, 25	
Electrical	Divisions 00, 01, 02, 13, 26	

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

DRAWING LIST

Drawing #	Title
ME-1	**Legends, Site Plan, Schedules and Drawing List**
ME-2	**Ground Floor Plan – Demo and New**
ME-3	**Roof Plan – Demo and New**
ME-4	**Schematics**
ME-5	**Sections and Details**

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK COVERED BY CONTRACT DOCUMENTS

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown on the drawings or in the Project Specification. Work shall be in accordance with the specifications and their intent, complete with all necessary components, including those not normally shown or specified, and shall be ready for operation before acceptance.

.2 The Mechanical Contractor shall be the Prime Contractor for the project and shall include all required sub trades including general contract trades, electrical, controls and any others as required to ensure a complete installation.

.3 Heating, Cooling and Ventilation Systems:

.1 The new installation shall meet the current building standards in all aspects and shall meet all code requirements.

.2 Remove existing air handling unit xAHU-3 mounted on the roof of the office area as indicated on the contract drawings. Remove parts of the existing ductwork and equipment on the ground floor level and roof of the Buoy Maintenance Building as indicated on the contract drawings.

.3 Existing structural steel to be re-painted and evaluated by structural engineer with respect to new air handling unit weight. Provide additional primed and painted support platform/rails as required to mount the unit on the existing steel frame.

.4 Provide new gas fired make up air unit AHU-3 mounted on the roof of the office area. Modify existing heating, cooling and ventilation systems to re-purpose AHU-3 to serve the entire BMB Shops area and provide tempered make-up air for the paint room.

.5 Provide sheet metal air intake weather hood facing downwards. Air intake to be protected against nesting of birds. Sheet metal according to specifications.

.6 Provide control wiring and power supply with local disconnect switch.

.7 Existing natural gas line to be extended (40 mm) to serve AHU-3. Site confirm connection size and location and provide seismic shut-off valve and gas regulator.

.8 Provide new multi-zone heat pumps system to serve the ground floor level of the Buoy Maintenance Building as indicated on the contract drawings. Two (2) outdoor heat pumps are to be mounted on the roof and -three (3) indoor heat pumps mounted in ceiling spaces complete with ductwork and air terminals.

.9 Heat pump fan coil mounted in ceiling space and connected to existing ductwork as indicated on contract drawings. Remove supply, return and/or exhaust duct as indicated on the contract drawings to allow new system installation.

.10 Provide refrigeration piping, power supply, controls wiring from the outdoor unit to the indoor fan coil. Discharge duct from fan coils to be 1000 x 150 (uno) and return duct to be return connection size. Return boot to be provided with acoustic insulation.

.11 Provide pumped condensate, 12 mm diam. from coil drain pan, up through roof to outdoors. All roof penetrations to be horizontal, through side of roof cap, complete with flashing and sealing water-tight.

.12 Seismically restrain fancoil units. Rebalance existing air terminals to the air flow indicates on contract drawings. Indoor heat pumps to be complete with vibration isolation hangers, seismic restraint and flex connections on supply air and return air ductwork connections.

.13 Heat pump mounted on existing roof curbs. Provide primed and painted support platform for hp-100 & hp-200. Anchors for steel platform to be on side of curbs, have flashing and be sealed watertight.

.14 Provide new supply and exhaust air ducts and transition as required to connect to inlet and outlet of HRV-1. Balance o/a flow to each fan coil at 140l/s. Connect each o/a duct to fan coil return plenum. Clean existing air ductwork before re-used.

.15 Replace the existing paint kitchen exhaust fans by new as per existing capacities. Fan capacity and sizing needs to be determined. Photo's of existing fans are provided in Appendix M.

.16 Replace/modify existing paint room controls to provide control devices as indicated in the paint room detail on contract drawings and sequences of control. Provide control display screen and NEMA 1 enclosure(s).

.17 Install a roof mounted air source heat pump HP-HW and associated hydronic system. Heat pump heating system to be complete with pumps, piping, storage tanks, unit heaters, expansion tank and control devices.

.18 Heating system heat pump mounted on existing roof curbs. Provide primed and painted support platform for HP-HW to spread the weight of the unit over 75% of the existing roof curbs. Anchors for steel platform to be on side of curbs, have flashing and be sealed watertight.

.19 Provide primed and painted steel support/protection cage for the storage tank, the expansion tank and the glycol mixing tank. Heating glycol loop to be filled automatically from the glycol mixing tank when the pressure at the storage tanks drops below 207 kpa (30 psi).

.20 Seismically anchor to floor. Site confirm best location for piping risers.

.21 Mount unit heaters as high as possible, in joist space. Ensure all piping and wiring is clear of the overhead crane. Glycol supply and return at high level. Provide diffuser beside each unit heater. Fans to be controlled by DDC system.

.22 All equipment supplied must provide clearance for the overhead crane and other shop equipment. The contractor shall confirm that all equipment is clear of the crane by traversing the crane through its full movement.

.23 Retain existing fire dampers.

.24 Provide new timer switch (30, 60, 120 min and off) in NEMA 4X enclosure to control existing supply air dampers to preparation area as indicated on contract drawings. Provide limacoid label to indicate 'set timer for low level supply air'.

.25 On the existing mezzanine level, provide new 5 hp, 600v 3 phase 4 wire variable speed drives for xef-pr1 and xef-pr2. Mount vsd's and line filters on welded, prime and painted steel support stand fastened to floor. Maintain service access to paint room lights and do not block removable floor plate. Maintain 1 m clearance in front of vsd's. Re-use the fan motor in xef-pr1 and provide a new high efficiency, electric motor to replace the fan motor in xef-pr2. Provide power supply from paint room control panel, to vsd's and to exhaust fans. Provide control wiring as required. Repair connections to existing filter p-gauge.

.26 Modify existing equipment, ductwork and air terminals to suit the new HVAC systems.

.4 Controls:

.1 Provide a set of independent controls for the new heat pump equipment complete with programmable thermostats.

.2 Provide a direct digital control system compatible with the existing Delta BACnet DDC system installed by Island Temperature Control to control and monitor the new HVAC equipment as indicated in the controls specification and on the contract drawings.

.3 Work includes DDC system hardware, points list, panel wiring, program code, graphic screens, trending, commissioning and documentation

.5 Electrical:

.1 Provide a new floor-mounted transformer and two electrical panels in order to provide electrical services to new mechanical equipment.

.2 Remove existing 45kva 600-120/208v 3Ø 4w transformer, wiring and conduit back to source. Return existing 60a-3p breaker in electrical panel 'b' to owner. Provide a new 75kva 600-120/208v 3Ø 4w transformer in the same location as existing, and provide a new 100a-3p breaker in electrical panel 'b'. Route 3#3 +#8 grn. Gnd.-35mm (1.25")c.

.3 Provide a new 225a 120/208v 3Ø 4w 24cct. Electrical panel 'ba' c/w 200a-3p main breaker. From the new 75kva transformer, route 4#300 +#4 grn. Gnd.-78mm(3")c. Connect the lugs of new electrical panel 'ba' with existing electrical panel 'a' using 4#3/0+#6 grn. Gnd. - 63mm (2.5")c.

.4 Provide a new 225a 347/600v 3Ø 4w 24cct. Electrical panel 'bb' in the location shown. Provide a new 150a-3p breaker in electrical panel 'b', and route 4#1/0+#6 grn. Gnd. - 53mm (2")c. Ensure minimum 1m clearance in front of panel.

.5 Provide a 15a-2p breaker in electrical panel 'ba' for all unit heaters uh-1,uh-2,uh-3 and uh-4. Provide motor rated magnetic starter c/w manual on-off switch and overcurrent protection mounted on each unit heater and route 2#12+#12 grn. Gnd. - 16mm(1/2")c.

.6 Provide a new 15a-1p breaker in electrical panel 'ba' and a 120v 30a-1p unfused safety switch on the nearest wall for glycol mixing tank. Route 2#12+#12 grn. Gnd. - 16mm (1/2")c .

.7 Provide breakers in existing power, panels, starters, MCCs, safety switches, conduit and wiring for the new HVAC equipment.
Provide a new 30a-2p unfused safety switch mounted on fan coil units and route 2#12+#12 grn. Gnd.-16mm (1/2")c from associated outdoor unit.

.8 Provide new variable speed drives and one electric motor for existing paint room exhaust fans xEF-PR1 and xEF-PR2.

.9 Remove paint kitchen exhaust fans xEF-6 and xEF-7, reuse and extend existing breakers, wiring and conduit where possible to weatherproof 30a-1p unfused safety switches mounted on each unit. Allow for capacities as per equipment schedules, however existing fan capacities to be site confirmed.

.10 For all outside, electrical conduits and connections shall use liquid tight connectors. All electrical devices shall be waterproof. Refer to contract drawings for electrical roof penetration details.

.11 Provide a new 15a-1p breaker in panel 'ba' and route 2#12+#12 grn.gnd.-16mm (1/2")c for the three motorized dampers, and provide weather proof enclosure/cover for each.

.12 Provide a new 15a-1p breaker in electrical panel 'ba' and route 2#12+#12 grn. Gnd.-16mm (1/2")c for a new gfi receptacle c/w weatherproof cover min 300 above roof.

.13 Provide a new 60a-3p breaker in electrical panel 'bb', and a weatherproof 600v 60a-3p unfused safety switch on unit. Route 4#6+#10 grn.gnd.- 27mm(1")c for HP-HW.

.14 Provide a new 60a-3p breaker in electrical panel 'bb' and a waterproof 600v 60a-3p unfused safey switch on AHU-3. Route 4#6+#10 grn.gnd.- 27mm (1")c.

.15 Provide a new 30a-2p breaker in electrical panel 'ba' and a weatherproof 208v 30a-2p unfused safety switch for mechanical equipment. Route 2#10+#12 grn. Gnd. - 21mm (3/4")c.

.16 Remove and dispose of all redundant electrical conduit and wiring that are not re-used in this project. Turn over electrical devices to owner as indicated.

.17 Contractor shall modify/relocate/replace existing ceiling, light fixture, ductwork and piping supports and misc wiring, and elect. Conduit 20 mm diam and less as required to install the new equipment. The contractor shall also allow for the relocation of two lighting fixtures to adjacent locations to allow for better service access to equipment. Locate access panels to provide the best service access.

.6 General:

.1 The building HVAC systems shall remain in operation during renovations except for short periods during the switch over from the existing systems to the new systems. The existing hot water heating system and various ventilation systems currently provide heating ventilation and partial cooling.

.2 General contract work includes roof work to install penetrations and equipment roof curbs. Roofing work to be provided by a contractor who is a registered member of the Roofing Contractor's Association of British Columbia (RCABC)

.3 Startup, commissioning, documentation of the mechanical systems and controls.

1.2 CONSTRUCTION SCHEDULE

.1 Contractor shall provide a construction schedule within two weeks after the contract is rewarded.

1.3 WORK BY OTHERS

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

.2 Co-ordinate work with other Contractors. If any part of work under this Contract depends on proper execution by or relies upon work of another Contractor, report immediately to the Consultant in writing, any situations which may interfere with proper execution of Work.

1.4 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for Work, and for storage to allow:

.1 Owner occupancy during the construction period.

.2 Work by other contractors.

.2 Co-ordinate use of premises under direction of the Base Operations Manager.

.3 Allow for after hours construction and clean up before office hours resume in each morning.

.4 Construction works on weekends will be allowed, subject to the base operations managers approval.

.5 Ceiling tiles may be removed at the start of demolition and left open until the construction work is complete.

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

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

.8 Contractor will re-install the bird wire system on the roof (if they need to remove it during construction phase).

.9 Repair or replace portions of existing work which have been altered during construction to match existing or adjoining work.

.10 At completion the work: ensure premises condition for the work area to be equal or better than that which existed before the work started.

1.5 OWNER OCCUPANCY

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

.2 Co-operate with the building manager in scheduling operations to minimize conflict and to facilitate occupancy.

1.6 WORK IN EXISTING BUILDINGS

.1 All work on site shall be co-ordinated with the Building or Base Manager so as to minimize disruptions. Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with Building Manager to facilitate execution of work.

.2 Equipment locations shown on contract drawigns are approximate and the contractor shall confirm best exact locations to suit site conditions. The contractor is to resupport and re-connect flexible ductwork for approximately four of the existing diffusers which have become disconnected.

.3 Use only designated elevators, existing in building for moving workers and material.

.4 Obtain approval from the Departmental Representative prior to penetrating any structural surfaces including floor slabs. Obtain from the Building Manager approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.5 Carefully route new conduits and other new services so that they do not interfere with existing installation. Arrange and pay for any necessary relocation of existing conduit, cable tray, bus duct or any other services required for the proper installation of new Work.

.6 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Departmental Representative.

.7 All Contractors shall exercise due care and diligence in working in the occupied areas. Keep the worksite clear of waste material and rubbish at all times during progress of the work. Clean up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.8 Protect all existing services and make good any damage occasioned by the work in this contract.

.9 The Department reserves the right to complete and/or repair any work that is not in operating condition, beyond scheduled shutdowns, in order to maintain the Department's operation.

1.7 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods.

.2 The office and workshop areas are to be kept in operation during demolition and construction. Short service outages (1-30 minutes) shall be allowed during office hours if and when coordinated with the base operations manager.

.3 Outages shall be pre-planned and at least 96 hours of notice provided before the outage.

.4 Any service outages which affect the operations of the computer servers must be pre-approved and the duration of the outage minimized. Measures shall be taken to protect computer, electronics and personal equipment in the facility.

.5 Co-operate with the Department and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time.

.6 Notify Base Manager of intended interruption of services and obtain required permission.

.7 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

1.8 PRECEDENCE

.1 For Federal Government projects, Division 1 Sections take precedence over technical specifications in other Division of this Project Document.

1.9 LOCATION OF SITE

.1 The project site is one of the buildings on the Canadian Coast Guard Base Victoria, located at 25 Huron Street, Victoria BC, V8V4V9.

1.10 DOCUMENTS REQURIED

.1 Maintain one copy of each of the following documents: Contract drawings, Contract Specifications, Addenda to Contract documents, Reviewed Shop Drawings, Change orders, Other Contract modifications, Professional Compliance Reports, Product Test Data, Suppliers/manufacturer's instructions and recommendations, material and product information.

1.11 WORK SCHEDULE

.1 Within five (5) working days after contract award, provide a schedule showing anticipated progress stages and final completion of the work.

.2 All work is to be completed and commissioned by October 31, 2021.

1.12 PROJECT MEETINGS

.1 The Department or Engineer of Record may arrange for project meetings, from time to time.

.2 The Department may furnish additional drawings to assist proper execution of the work. These drawings will be issued for clarification only and will have the same meaning and intend as if they were included with drawings referred to in the Contract documents.

1.13 CODES & STANDARDS

.1 Perform all work in accordance with Standards and codes identified in the Contract documents.

.2 Related codes include but are not limited to; CSA ULC, National Building Code, BC Building Code and the National Fire Protection Association.

.3 The manufacture shall have a good standing with the WorkSafe BC and all federal, provincial and local regulators.

.4 In case of any conflict or discrepancy between referenced codes, standards and regulations, the most stringent requirements shall apply.

.5 Contractor shall meet or exceed the requirements of specified standards, codes and reference documents.

1.14 PERMITS AND NOTIFICATIONS

.1 Obtain and pay for all permits that are required.

.2 Conform to noise bylaws and requirements of local authorities impacted by the work.

.3 Notify Environment Protection Service and the local Fisheries Officer at least five (5) days before work begins.

1.15 MATERIAL AND EQUIPMENT

.1 All equipment and materials used for construction shall be new, unless specified otherwise.

.2 Record the following information on the equipment and materials to be provided on this project; project name, address of manufacture, trade name, model number, performance and construction information.

.3 SI metric units shall be used exclusively on the drawings

.4 No substitution will be permitted without prior written approval of the Owner.

1.16 INTERPRETATION

.1 In interpreting the Contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions shall govern.

.2 In the event of any discrepancies or conflicts between other documents, the Specifications shall govern the Plans and both the Plans and Specifications shall govern the Appendices.

1.17 REQUIREMENTS OF REGULATORY AGENCIES

.1 Ensure work meets all applicable environmental regulations.

.2 Contractor shall comply with all municipal, provincial and national regulatory agency regulations relating to this project.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

.1 Plan "access to" and "egress from" work areas through a manned gateway controlled by the Canadian Coast Guard. Access to the site must be coordinated through the Base Operations Manager.

1.2 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with the Consultant to facilitate work as stated.

.2 Hours of Work:

.1 Perform work between normal hours of 07:00 to 16:00, Monday to Friday, except holidays and in accordance with local noise bylaws.

.2 Work may be performed after working hours, on weekends and holidays as approved by Departmental Representative.

.3 Use of site: limited to immediate area of the work and areas assigned by the Departmental Representative for office storage, equipment, stock piles, sanitary facilities, etc.

.4 Vehicles entering and left in designated work area must have Contractor's logo/name clearly marked on the vehicle.

.5 Arrange parking in areas directed by Departmental Representative. Maintain construction parking area clean and free of construction related debris. Make good damage resulting from Contractor use of parking areas, at no cost to the Contract.

.6 Confine work and operations of employee to areas defined by the Contract Documents unless directed otherwise in writing by the Departmental Representative. Do not unreasonably encumber premise with products.

.7 Maintain existing services to building and provide for personnel and vehicle access.

.8 Where security is reduced by work provide temporary means to maintain security.

.9 The building manager will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.

.10 Use only stairs existing in building for moving workers and material.

.1 Protect walls to approval of the building manager prior to use.

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

.11 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance to building operations and occupants and normal use of premises. Arrange with the building manager to facilitate execution of work.

1.4 EXISTING SERVICES

.1 Notify the building manager and Consultant of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give the Base Manager minimum of 96 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 Computer server equipment is used on site and electrical service shall not be interrupted without written permission.

1.5 SPECIAL REQUIREMENTS

.1 Schedule applies all items of the Work defined in Section 01-11-00 Summary of Work

.2 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

1.6 SECURITY CLEARANCES

.1 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

1.7 SECURITY ESCORT

.1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.

.2 Submit an escort request to the (Owner) (building manager) at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be at no cost to the Contractor. Cost incurred by late request will be Contractor's responsibility.

.3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.

.4 Calculation of costs will be based on average hourly rate of security officer for four hours for late cancellations.

1.8 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not allowed in the building or on the property.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Construction Documents - Stipulated Price Contract.

1.2 GENERAL

.1 Refer to Form of Tender.

1.3 TAXES

.1 Refer to TAXES & DUTIES in Form of Tender.

.2 The Contractor shall show Canadian Federal Goods and Services Tax and British Columbia Sales Tax as separate entry on all invoices submitted.

1.4 MANNER OF PAYMENT

.1 Refer to Form of Tender.

Part 2 Products

2.1 Not Applicable

Part 3 Execution

3.1 Not Applicable

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedure.

.2 Section 01 11 00 – Summary of Work.

.3 Section 25 05 01 - EMCS General Requirements.

.4 Section 01 91 13 - Testing and Commissioning

1.2 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 another 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 involve using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

1.3 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 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.4 SUBMITTALS

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

.2 Submit to Departmental Representative within 15 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 10 working days of receipt of acceptance of Master Plan.

1.5 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

.1 Substantial Completion within 90 working days of Award of Contract date.

1.6 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 schedule if requested and resubmit within 5 working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.7 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 Submittal

.3 Shop Drawings Approval

.4 Mobilization.

.5 Material / Devices Ordering and Delivering to Site.

.6 Construction, phasing of work

.7 Testing and Commissioning.

1.8 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on bi-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.

1.9 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 78 00 – Closeout Submittals.

1.2 ADMINISTRATIVE

.1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, 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 Consultant. 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 Consultant, 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 Consultant's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow 14 business days for Consultant's review of each submission.

.4 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.5 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.

.6 Accompany submissions with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Other pertinent data.

.7 Manufacturer's printed data sheets for standard items are acceptable, provided that pertinent characteristics are identified and related to specified items.

.8 Submission of **scanned catalogue pages, website information sheets or product brochures** that **do not** contain relevant technical details, drawings / depictions and notations are **NOT** acceptable and will result in rejection of submissions.

.9 Submission of drawings that are improperly labelled, not labelled, or that are deemed unsightly shall be rejected.

.10 Submissions 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.

.11 After Consultant's review, distribute copies.

.12 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

.13 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.

.14 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.15 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.16 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Consultant.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

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

.18 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant.

.19 Delete information not applicable to project.

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

.21 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned, and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.22 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that the Department or Departmental Representative 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.

.23 Each shop drawing shall be **checked** and **stamped** as being correct, by trade purchasing item, and by the Contractor, before drawing is submitted to Consultant for review. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

.24 Do not have equipment delivered to site until a shop drawing for the item has been reviewed, stamped as accepted or modified by Consultant and returned to Contractor.

1.4 EQUIVALENCY

.1 Manufacturer products listed in these specifications are provided as materials or equipment already reviewed and accepted for inclusion in the Work. These listed materials or equipment demonstrate the minimum quality and performance of materials and equipment that manufacturers offerings and requests for equivalency must demonstrate in order to be considered for inclusion in the project.

.2 Unless stated 'no equivalent', manufacturers, their agents or representatives may and are invited to submit materials or equipment for consideration as equivalent to listed materials or equipment by submitting written request to the Consultant and providing information for submittals as detailed within these specifications.

1.5 DETAIL DRAWINGS AND INSTRUCTIONS

.1 Submit notification of locations where installation of equipment would interfere with interior treatment or use of building. Detail drawings or instructions exactly locating these items will then be issued.

.2 Submit all the drawings respecting the work to the Consultant, upon request, for acceptance before using them. Contractor is responsible for performing the work properly notwithstanding such acceptance.

.3 Perform the work in accordance with drawings and instructions supplied by the Consultant but do not use such drawings for construction, manufacture or installation unless the Consultant has released them for such use.

.4 Inform the Consultant of any instructions given by any parties that would affect the equipment, quantities, locations, price, or any modification to the work as outlined in this Contract. Failure to comply may result in the rejection of the work or any associated costs.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products – NOT USED

Part 3 Execution

3.1 GENERAL

.1 Submittals shall be submitted promptly and in an orderly sequence so as to not cause delay in the Work. No extension of the contract time, or any standby claims will be considered should the Contractor fail to submit the required Submittals in the required time.

.2 The Contractor shall review submittals prior to submission to the Consultant. This review represents that all the necessary requirements have been determined and verified, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified by the Contractor will be returned without being examined and will be considered rejected.

.3 The Contractor is responsible for the accuracy and completeness of information submitted. The Contractor shall notify the Consultant in writing of materials, equipment or methods of work that deviates from the Contract Documents.

.4 Once reviewed the Contractor shall keep one (1) copy of each approved submittal on site.

3.2 SUBMITTALS FOR REVIEW

.1 All submittals shall to be submitted by the Contractor to the Consultant for review, except where specified to be submitted for information only.

.2 Submittals for review will be returned to the Contractor with one of the following notations:

.1 "Reviewed" - Material or equipment complies with the Contract Documents. In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

.2 "Reviewed as Modified" - Indicates limited modifications are required. The Contractor may begin implementing the work method or incorporating the material and equipment covered by the Submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, the Contractor shall provide a corrected copy.

.3 "Revise and Resubmit" Indicates that the submittal is insufficient or contains incorrect data. The Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "Reviewed" or "Reviewed as Modified".

.4 "Rejected - See Remarks" – Indicates that the material, equipment, or work method does not comply with the Contract Documents. The Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "Reviewed" or "Reviewed as Modified".

.3 Where it is known by the Contractor that a submittal does not comply with the Contract documents, the deviation from compliance shall be clearly marked. Failure to do so may result in the submittal being rejected.

.4 The Department may deduct, from payments due to Contractor, costs of additional Engineering reviews incurred if shop drawings and data sheets are not corrected after two (2) reviews by the Consultant.

3.3 SUBMITTALS FOR INFORMATION ONLY

.1 'Submittals for information only' will be used by the Consultant for general information and filed without comment. The Consultant retains the right to return 'Submittals for information only' if the submittal does not comply with the Contract Documents and general design criteria.

.2 'Submittals for information only' are not subject to review procedures. They are to be provided as part of the Work under the Contract and their acceptability determined under normal inspection procedures.

.3 Request for Material Substitution

.1 Submittals for substitution shall contain sufficient technical detail to allow the Consultant to determine if the proposed product is truly equivalent or better than the specified product. Submittals lacking detail will not be considered.

.2 Submittals shall also contain any details on cost savings to the Corporation, should the substitution be approved.

.3 The final decision on the use of the proposed product, or material is at the sole discretion of the Consultant.

.4 All requests for material substitutions must be submitted no later than three business days prior to the close of tender or request for pricing.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Government of Canada

.1 Canada Labour Code, Part 2,

.2 Canada Occupational Safety and Health Regulations

.2 National Building Code of Canada (NBC):

.1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 The Canadian Electric Code (as amended)

.4 Canadian Standards Association (CSA) as amended:

.1 CSA Z797-2009 Code of Practice for Access Scaffold

.2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes

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

.4 CSA Z1006-10 Management of Work in Confined Spaces.

.5 CSA Z462- Workplace Electrical Safety Standard

.5 National Fire Code of Canada 2010 (as amended)

.1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

.6 American National Standards Institute (ANSI):

.1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.7 Province of British Columbia:

.1 Workers Compensation Act Part 3-Occupational Health and Safety

.8 Occupational Health and Safety Regulations

.9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

1.3 SECTION INCLUDES

.1 Health and safety considerations required to ensure that the contractor shows due diligence towards health and safety on construction sites and meets Occupational Health and Safety requirements.

1.4 WORKERS' COMPENSATION BOARD COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.5 COMPLIANCE WITH REGULATIONS

.1 DFO may terminate the Contract without liability to DFO where the Contractor, in the opinion of DFO, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.6 SUBMITTALS

.1 Make submittals to Departmental Representative submittals listed for review in accordance with Section 01 33 00 – Submittal Procedures.

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

.1 Site Specific Health and Safety Plan.

.2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.

.3 Copies of incident and accident reports.

.4 Complete set of current Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.

.5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's Site-Specific Health and Safety Plan and emergency procedures and provide comments to the Contractor within 10 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative

.6 Submission of the Site-Specific Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

.1 Be construed to imply approval by the Departmental Representative.

.2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

.3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.7 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.3 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

.4 Secure site at nighttime [or provide security guard] as deemed necessary to protect site against entry.

1.8 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Multi-employer work site.

.2 Federal employees and general public.

1.9 UTILITY CLEARANCES

.1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work

.2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.

1.10 REGULATORY REQUIREMENTS

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.11 WORK PERMITS

.1 Obtain speciality permit[s] related to project before start of work.

1.12 FILING OF NOTICE

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

1.13 HEALTH AND SAFETY PLAN

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Comply with DFO Site Safety Plan. Prior to starting work on site, Contractors and Sub-contractors will require to view the "CCG/DFO Site Safety Video located at Victoria CCG Base.

.3 Contractors and Sub-contractors must complete and submit a Cocid-19 Screening Form before entering the site. In addition, Contractors and Sub-contractors will be required to take temperature readings and answer Covid-19 related questions on daily basis before entering the site.

.4 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy.

.2 Identification of applicable compliance obligations.

.3 Definition of responsibilities for project safety/organization chart for project.

.4 General safety rules for project.

.5 Job-specific safe work procedures.

.6 Inspection policy and procedures.

.7 Incident reporting and investigation policy and procedures.

.8 Occupational Health and Safety Committee/Representative procedures.

.9 Occupational Health and Safety meetings.

.10 Occupational Health and Safety communications and record keeping procedures.

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work.

.4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify Personal Protective Equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.5 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.6 Revise and update Health and Safety Plan as required and re-submit to the Departmental Representative.

.7 Departmental Representative's review: the review of Site-Specific Health and Safety Plan by Department of Fisheries and Ocean (DFO) shall not relieve the Contractor of responsibility for errors or omissions in final Site-Specific Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.14 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:

.1 Designated personnel from own company.

.2 Regulatory agencies applicable to work and as per legislated regulations.

.3 Local emergency resources.

.4 Coast Guard Base Representative.

.2 Include the following provisions in the emergency procedures:

.1 Notify workers and the first-aid attendant, of the nature and location of the emergency.

.2 Evacuate all workers safely.

.3 Check and confirm the safe evacuation of all workers.

.4 Notify the fire department or other emergency responders.

.5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.

.6 Notify site staff and Departmental Representative.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:

.1 Work at high angles.

.2 Work in confined spaces or where there is a risk of entrapment.

.3 Work with hazardous substances.

.4 Underground work.

.5 Work on, over, under and adjacent to water.

.6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

1.15 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials

.2 Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.3 Where use of hazardous and toxic products cannot be avoided:

.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per submittal procedures.

.2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.

.3 Provide adequate means of ventilation.

.4 The contractor shall ensure that the product is applied as per manufacturers recommendations.

.5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

1.16 ASBESTOS HAZARD

.1 Carry out any activities involving asbestos in accordance with applicable Provincial / Federal Regulations.

.2 Removal and handling of asbestos will be in accordance with applicable Provincial / Federal Regulations.

1.17 SAFETY ASSESSMENT

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

1.18 RESPONSIBILITY

.1 Assume responsibility as the Prime Contractor for work under this contract.

.2 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.

.3 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.

1.19 COMPLIANCE REQUIREMENTS

.1 Comply with Workers Compensation Act, B.C. Reg.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.20 PCB REMOVALS

.1 Mercury-containing thermostats and fluorescent tubes and ballasts which contain polychorinated biphenyls (PCBs) are classified as hazardous waste.

.2 Remove, handle, transport and dispose.

1.21 REMOVAL OF LEAD CONTAINING PAINTS

.1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.

.2 Carry out demolition and/or remediation activities involving lea containing paints in accordance with applicable Provincial Territorial Regulations.

.3 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.

.4 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.22 ELECTRICAL SAFETY REQUIREMENTS

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.

.2 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.

.3 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.23 ELECTRICAL LOCKOUT

.1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a logbook for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.24 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.25 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1- 1975 (R2003).

1.26 SCAFFOLDING

.1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 and B.C. Occupational Health and Safety Regulations.

1.27 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Provincial / Territorial Regulations

1.28 FIRE SAFETY AND HOT WORK

.1 Obtain Base Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

1.29 FIRE SAFETY REQUIREMENTS

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.30 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

.3 Left inactive at the end of a working day or shift.

.4 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.5 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.31 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

1.32 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with mechanical and electrical systems installation.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, revising, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.33 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 having jurisdiction, and in consultation with Departmental Representative.

.2 Post legible versions of the following documents on site:

.1 Site Specific Health and Safety Plan.

.2 Sequence of work.

.3 Emergency procedures.

.4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.

.5 Notice of Project.

.6 Floor plans or site plans.

.7 Notice as to where a copy of the Workers' Compensation

.8 Workplace Hazardous Materials Information System (WHMIS) documents.

.9 Material Safety Data Sheets (MSDS). List of names of Health and Safety Representative, as applicable.

.3 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.4 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.34 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.

1.35 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 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

Part 2 **Products - NOT USED**

Part 3 **Execution - NOT USED**

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Federal Halocarbon Regulations (FHR), 2003 (SOR/2003-289).

.2 DFO National Halocarbon Environmental Management Procedure.

.3 Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems (Environment Canada).

.4 The Servicing of Halon and Clean Agent Extinguishing Systems (Underwriter's Laboratories of Canada) (ULC/ORD-C1058.18-2004).

1.2 ATTACHMENTS

.1 DFO ROEC Halocarbon Site Management Procedure.

.2 Environment Climate Change Canada Guide for Individuals and Organisations: What you need to know about the Federal Halocarbon Regulations, 2003 (Cat. No. EN14-24/2010E-PDF; ISBN 978-1-100-16457-1).

.3 Environmental Management Plan, Halocarbon Management Site Procedure, Annex A, Contractor Awareness Document.

.4 Environment Canada Fact sheet - Federal Halocarbon Regulations, 2003 : information pertaining to refrigeration and air-conditioning systems (Cat. No. En14-108/1-2013E-PDF; ISBN 978-1-100-22780-1).

.5 Environment Canada Fact sheet - Federal Halocarbon Regulations, 2003 : information pertaining to chillers (Cat. No. En14-108/2-2013E-PDF; ISBN 978-1-100-22782-5).

.6 Environment Canada Fact sheet - Federal Halocarbon Regulations, 2003 : information pertaining to fire-extinguishing systems (Cat. No. En14-108/3-2013E-PDF; ISBN 978-1-100-22783-2).

.7 Environment Canada Fact sheet - Federal Halocarbon Regulations, 2003 : information for service contractors pertaining to refrigeration and air-conditioning systems (Cat. No. En14-108/4-2013E-PDF; ISBN 978-1-100-22784-9).

.8 Environment Canada Fact sheet on halons in fire-extinguishing systems: phase-out and disposal (Retrieved from https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/ozone-layer/measures-protect/federal-halocarbon-regulations-information/fact-sheet-halons-fire-extinguishing-systems.html)

.9 Halocarbon Cooling Capacity Treshold Info Sheet, version 1.0, 2019.

.10 Halocarbon Decommissioning and Disposal Info Sheet, version 1.0, 2018.

.11 Halocarbon Installation Requirements Info Sheet, version 1.0, 2018.

.12 Halocarbon Systems Work Flow Info Sheet, version 1.0, 2019.

Above indicated references have been attached to this specification in full and Contractor shall meet the requirements of the Federal Halocarbon Regulations (2003(SOR/2003-289).

1.3 INTRODUCTION

.1 Halocarbons are molecular compounds that consist of carbon combined with one or more halogens molecules. Halocarbons are broken down by ultraviolet radiation in the upper atmosphere and release free halogen atoms that damage the ozone layer; halocarbons have been implicated as greenhouse gases and contribute to global climate change. Halocarbons, chemical blends, and equipment containing halocarbons

.2 Fisheries and Oceans Canada (DFO) sites and facilities, including staff and contractors, must maintain compliance with the Federal Halocarbon Regulations, 2003 (SOR/2003-289) as per the Environmental Policy Statement for DFO Operations and Assets, the DFO regional Halocarbon Management Site Procedure, Environmental Management Plan, as amended from time to time by the DFO Regional Office of Environmental Coordination (ROEC).

1.4 DEFINITIONS

.1 Equipment Types: Air conditioner, Fire Extinguishing/Fire Suppression, Refrigeration, Solvent System (using Halocarbons)

.2 System Types: types of equipment can be further delineated into system types, such as: Large Refrigeration/AC system; Small Installed Refrigeration/AC system; Small Packaged system; Fixed Fire Extinguishing system; Portable Fire-Extinguishing system; Solvent system; Vehicle.

.1 Large Refrigeration/AC System (≥ 19kW (5.4 tons)): A refrigeration or air conditioning system, other than one that normally operates in, on or in conjunction with a means of transportation, that has a refrigeration capacity of at or more than 19kW (5.4 tons) as rated by the manufacturer. Examples: Main building chillers, Roof-top air conditions.

.2 Small Installed Refrigeration and AC System (<19 kW (5.4 tons)): Refrigeration capacity of less than 19 kW (5.4 tons) refrigeration output capacity as rated by the manufacturer. Examples: Heat pumps, Fixed air conditioning system with building-integrated circulation routes (non-mobile, non-window mounted), Chillers.

.3 Small Packaged System: Refrigeration capacity of less than 19kW (5.4 tons) refrigeration output capacity as rated by the manufacturer. Self-contained unit that can be plugged into standard outlet and does not require any re-wiring. Equipment is not serviced in its lifetime. Examples: Domestic or commercial refrigerator/freezer, Water cooler, Window-exhausted or mobile air conditioner.

.4 Fixed Fire-Extinguishing System: Includes all fixed fire-extinguishing systems that contains a halocarbon fire-extinguishing agent. Examples: Extinguishers containing FM-200, Halon-containing fire systems.

.5 Portable Fire-Extinguishing System: Includes all fire-extinguishing cylinders or cartridges that contain halocarbons, weigh 25kg (55 lb) or less and that can be carried or wheeled to the site of a fire.

.6 Solvent System: A system that uses halocarbons as solvents, including cleaning applications and associated equipment containing or designed to contain a halocarbon solvent. Examples: Materials washing machines (mechanical parts or tools, textiles, fabrics) which contain halon.

.7 Vehicle: Applicable only to vehicles that have an AC that uses halocarbons. Examples: Fleet or field vehicles.

.3 Certified Service Technician: someone who has completed the Refrigeration Code of Practice (Environmental Awareness in Ozone Depleting Substances) training and is trade qualified under the Provincial regulatory body. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.

.4 "Refrigerant Code of Practice": the Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems (Environment Canada).

.5 Installation: involves the placing of a halocarbon system into service, if it requires the work of a certified person (i.e. requires work that may result in a leak, requires leak testing, requires charging, etc.). It does not include the reactivation of a system by the same owner at the same site. Additionally, it does not include plugging in small packaged systems, such as domestic refrigerators and window air-conditioning units. Small Packaged Systems do not require the installation by a Certified Service Technician since all the equipment is pre-installed at the factory and no work that is required as part of the actual mounting/installation which would result in the release of any contained halocarbon.

.6 Contractor Awareness Document: An Environment Canada document that summarizes the contractor's responsibilities under the Federal Halocarbon Regulations. A Certified Service Technicians must review the Contractor Awareness Document prior to initiating work on the system.

1.5 CERTIFICATION AND TECHNICAL REQUIREMENTS OF SERVICE TECHNICIANS

.1 The following listing of requirements and certification is not required as part of the tender submittal documents but are considered trades requirements which shall be met in accordance with the Federal Halocarbon Regulations.

.2 Large and Small Installed Halocarbon-containing systems and equipment

.1 Valid Trade Qualification Certificate for Halocarbons (issued by Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)/Environment and Climate Change Canada/BC Ministry of Environment Certificate and a certificate number for refrigerant handling).

.2 Completed an "Environmental Awareness in Ozone Depleting Substances" (or similar) training (example: Ozone Layer Protection Awareness for Air Conditioning and Refrigeration Systems).

.3 Be aware of the Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems.

.4 Compliance to the Federal Halocarbon Regulations (SOR/2003-289).

.5 Reviewed Halocarbon Management Site Procedure and the 'Contractor Awareness Document'.

.3 Fixed Halon-containing Fire Extinguishing/Suppression Systems

.1 Completed a "Halon-containing Fire Systems Maintenance" (or similar) training.

.2 Be aware of the Servicing of Halon and Clean Agent Extinguishing Systems (ULC/ORD-C1058.18-2004).

.3 Compliance to the Federal Halocarbon Regulations (SOR/2003-289).

.4 Reviewed Halocarbon Management Site Procedure and the 'Contractor Awareness Document'.

1.6 SUBMITTALS

.1 Make submittals to Departmental Representative submittals listed for review in accordance with Section 01 33 00 – Submittal Procedures.

.2 Work effected by submittal shall not proceed until review is complete.

1.7 INSTALLATION, SERVICING, LEAK TESTING AND CHARGING OF HALOCARBON AND HALON-CONTAINING EQUIPMENT

.1 All halocarbon-containing equipment and fire extinguishing/suppression systems containing halon must be installed, serviced, leak tested and charged in accordance with the Federal Halocarbon Regulations (SOR 2003/289).

.2 As per the Federal Halocarbon Regulations, only a Certified Service Technician may install, service, leak test, charge, or do any other work that may result in the release of a halocarbon, and they must do so in accordance with the Refrigerant Code of Practice or The Servicing of Halon and Clean Agent Extinguishing Systems (ULC/ORD-C1058.18-2004).

.3 As per the Federal Halocarbon Regulations (FHR), only those servicing events or installations which could result in the release of a halocarbon (i.e. FHR 9(1)) need to be done by a certified service technician, and therefore be recorded using the Refrigerant Documentation Journal and Refrigerant Service Records (as per FHR 31(1)). Servicing events which could not result in the release of a halocarbon do not require the services of a certified service technician and do not need to be recorded using the Refrigerant Documentation Journal or associated Refrigerant Service Records.

.4 Both Large and Small Installed halocarbon-containing equipment requires the installation services by a Certified Service Technician. Record all information in the halocarbon Service Log Book. Small Packaged halocarbon-containing equipment does not require installation services by a Certified Service Technician. No information is required to be recorded in the halocarbon Service Log Book.

.5 Fixed Fire Extinguishing/Suppression Systems (whose cylinder or cartridge has a charging capacity of 10 kg or more) must be installed in accordance with the standards set out in the publication ULC/ORD-C1058.18-2004, of the Underwriters' Laboratories of Canada, entitled The Servicing of Halon and Clean Agent Extinguishing Systems.

.6 Large Installed halocarbon-containing equipment requires the services of a Certified Service Technician. For regulatory due diligence purposes, record the two certification numbers: the technician's Trade Qualification Certificate, and their Refrigerant Code of Practice (Environmental Awareness in Ozone Depleting Substances) certification. This can be done in the Comments section of the Service Log Book.

.7 Large Installed Halocarbon-containing equipment (>19kW (5.4 tons)) and Fixed Fire Extinguishing/Suppression Systems must be leak tested once every 12 months.

.8 Prior to charging any halocarbon-containing system, the system must be leak tested. If a leak is detected, the equipment must not be charged. Then, the owner (i.e. Real Properties) must be notified (by sending the Halocarbon Release Report to the ROEC) and the halocarbon system be repaired, isolated or the halocarbon recovered within 7 days.

.9 Prior to servicing a fixed fire suppression system, the owner must be notified and a notice must be affixed to the control panel indicating that it is out of operation during the period of service.

.10 Servicing of Fixed Fire Extinguishing/ Suppression System (FES) is to be done by proper fire system technician, and done so in accordance with the standards set out in the publication ULC/ORD-C1058.18-2004, of the Underwriters' Laboratories of Canada, entitled The Servicing of Halon and Clean Agent Extinguishing Systems.

1.8 DISPOSAL AND/OR DECOMMISSIONING

.1 Decommissioning involves permanently or temporarily removing a halocarbon-containing system from service. When decommissioning a system, the halocarbons must be removed before the equipment is sent for disposal.

.2 Disposal involves sending or taking the decommissioned system to a disposal and recycling facility.

.3 The form 'Disposal and Decommissioning Notice' is to be completed for both Disposal or Decommissioning processes and the same form can be used for both if referencing the same halocarbon system.

.4 The requirement to submit Disposal and Decommissioning Notices to ROEC for Small Packaged halocarbon-containing equipment disposal is not mandatory within the Pacific Region. Sites are encouraged to maintain their own records displaying environmentally sound halocarbon equipment decommissioning (removal of halocarbons) and disposal practices. Instructions for completing services notices are detailed within the DFO ROEC Halocarbon Site Management Procedure.

1.9 FORMS & RECORDS

.1 All servicing events which may result in the release of a halocarbon from the system or equipment (e.g. Installation, Charging, Servicing, Leak Testing, Disposal, or Decommissioning) must be recorded using the Refrigerant Documentation Journal, inside the Service Log Book (blue binder) along with any other applicable service notice forms (i.e. Disposal/Decommissioning), and must only be done by a Certified Service Technician. Please note that Disposal and/or Decommissioning Forms must be also be completed if applicable. Servicing events which could not result in the release of a halocarbon (i.e. electrical, or filter changes) do not need to be done by a Certified Service Technician with respect to halocarbons, nor need to be recorded in the Refrigerant Documentation Journal. Refrigerant Service Records (Service Notices) are located in the halocarbon Service Log Book (blue binder). They are attached to the left side of the Service Log Book over top of the refrigerant documentation journal sheets so that the first line of the notice is carbon copied onto the corresponding line on the documentation journal page.

.1 For activities related to the installation, servicing, leak testing and charging of halocarbon containing equipment, use the documentation journal and service notice forms in the blue service log book (blue binder). The Service Log Book is the blue binder which holds the Refrigerant Documentation Journal and Service Notice (Refrigerant Service Record) sheets. Each Large Refrigeration/AC System (>19kW (5.4 tons)) or Fixed Fire Extinguishing/ Suppression System should have its own service log book. However, a single log book can be used for all small equipment on site. Vehicle air-conditioning servicing does not need to be recorded in a Service Log Book, however any service records (i.e. invoices) should be maintained for 5 years.

.2 The Refrigerant Documentation Journal is a two-piece form (WHITE and YELLOW copy) located in the service log book. The documentation journal sheets must be filled out completely, with each row of the journal corresponding to one service event (i.e. installation, leak-testing, charging, servicing, or any other work done that may result in the release of a halocarbon). Half of the row from the journal is overlapped with the Service Notice (Refrigerant Service Record) form. This section of the journal is completed through carbon copying, and the other half of the row must be transferred from the service notice record.

.3 The service notices (refrigerant service records) must be filled out for each service event on each piece of equipment (i.e. installation, leak-testing, charging, servicing, or any other work done that may result in the release of a halocarbon).

.4 Once servicing has been completed, a Service Notice or Refrigerant Service Record must be completely filled out with all details, and physically affixed to the equipment and cannot be removed unless replaced by a new notice.

.5 Vehicle air-conditioning servicing does not need to be recorded in a Service Log Book, but records (i.e. invoices) of such work should be maintained for 5 years.

.6 In the event of an occupied site, records must be kept at the same address as the systems. For an occupied site, records must be kept at the office of the responsible site or program manager.

.7 All records must be kept for at least 5 years after their date of creation, including but not limited to: inventories of halocarbon-containing materials onsite, refrigerant service records, leak test notices, refrigerant documentation journal, disposal or decommissioning notices, and release reports.

.8 Any work which does not result in the release of halocarbon from the system or equipment does not need to be recorded using the Refrigerant Documentation Journal.

.9 The Halocarbon Release Report is a three-piece form (WHITE, PINK, and BLUE copy). These forms are to be completely filled out when a release of halocarbon has occurred, regardless of the type of equipment or the size of the release. Depending on the amount of halocarbon released, there are different reporting requirements and timelines for reporting. Instructions on when to report a release and how to complete a release report are detailed in the DFO ROEC Halocarbon Site Management Procedure.

.10 The Disposal or Decommissioning Notice is a two-part form (WHITE and YELLOW) that is to be completed for decommissioning (permanent or temporary) or disposal of halocarbon containing equipment. The requirement to

submit Disposal and Decommissioning Notices to DFO's ROEC for Small Packaged halocarbon-containing equipment disposal is not mandatory within the Pacific Region. Sites are encouraged to maintain their own records displaying environmentally sound halocarbon equipment decommissioning (removal of halocarbons) and disposal practices. Instructions for completing services notices are detailed in the DFO ROEC Halocarbon Site Management Procedure.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 35 29.06 – Health and Safety Requirements.

.2 Section 01 61 00 – Common Product Requirements.

.3 Section 01 74 11 – Cleaning.

.4 Section 01 74 21 – Construction/Deconstruction Waste Management and Disposal.

.5 Section 21 05 01 – Mechanical General Requirements.

.6 Section 26 05 00 – Common Work Results – Electrical.

1.2 INSPECTION

.1 Inspection of the construction work shall be conducted by the Departmental Representative and the Engineer of Record as required. The Contractor shall provide manpower and tools as required to assist with the inspections.

1.3 INDEPENDENT INSPECTION AGENCIES

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

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

1.4 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

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

1.6 REJECTED WORK

.1 Refer to Contract Documents.

1.7 REPORTS

.1 Submit one electronic copy of inspection and test reports to consultant.

.2 Supply 4 copies of inspection and test reports for inclusion in the O&M manual.

.3 Provide copies to subcontractor of work being inspected or tested.

1.8 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical and electrical systems.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 45 00 – Quality Control.

1.2 GENERAL

.1 Within text of each specifications section, reference may be made to reference standards. List of standards reference writing organizations is contained in Section.

.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be born by Department in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.3 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should disputes 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 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.

.4 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.

.5 Store sheet materials on flat, solid supports and keep clear of ground. Slope to shed moisture.

.6 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.

.7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.8 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 Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and 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 and Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative and Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.9 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.10 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. Co-ordinate adjacent affected Work as required.

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

1.12 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. 316L 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 parts of building. Do not cut, drill or sleeve 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 - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 – Submittal Procedure.

.3 Section 01 45 00 – Quality Control.

.4 Section 01 74 21 – Construction/Deconstruction and Waste Management Disposal.

1.2 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions.

1.3 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.6 Dispose of waste materials and debris at designated dumping areas.

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

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

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

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

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

1.4 FINAL CLEANING

.1 Final cleaning shall include removal of all redundant construction material and cleaning of all work areas.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products - NOT USED

Part 3 Execution `NOT USED

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss Waste Management Plan and Goals.

.2 Waste Management Goal is for 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.

.3 Accomplish maximum control of solid construction waste.

.4 Preserve environment and prevent pollution and environment damage.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedure.

.2 Section 01 74 11 – Cleaning.

1.3 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Inert Fill: inert waste - exclusively asphalt and concrete.

.3 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.4 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.5 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.6 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.7 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.8 Salvage: removal of structural and non-structural materials from deconstruction / disassembly projects for purpose of reuse or recycling.

.9 Separate Condition: refers to waste sorted into individual types.

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

.11 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.12 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.4 DOCUMENTS

.1 Maintain at job site, one copy of following documents:

.1 Waste Reduction Workplan.

.2 Material Source Separation Plan.

1.5 SUBMITTALS

.1 Prepare and submit following prior to project start-up:

.1 Submit completed Waste Reduction Workplan (WRW): Schedule B.

.2 Submit Materials Source Separation Program (MSSP) description.

.2 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.

.1 Failure to submit could result in hold back of final payment.

1.6 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:

.1 Destination of materials listed.

.2 Deconstruction/disassembly techniques and sequencing.

.3 Schedule for deconstruction/disassembly.

.4 Location.

.5 Security.

.6 Protection.

.7 Clear labelling of storage areas.

.8 Details on materials handling and removal procedures.

.9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

.3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials based on information acquired from WA.

.6 Post WRW or summary where workers at site are able to review content.

1.7 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated material in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

.1 Transport to approved and authorized recycling facility.

1.8 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.4 Protect surface drainage, mechanical and electrical from damage and blockage.

.5 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-site source separation is recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

.3 Provide waybills for separated materials.

1.9 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, oil, or paint thinner into waterways, storm, or sanitary sewers.

.3 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Total tonnage generated.

.4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials from deconstruction as deconstruction/disassembly work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis.

1.10 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Maintain security measures established by existing facility.

1.11 SCHEDULING

.1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 APPLICATION

.1 Do Work in compliance with WRW.

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

3.2 MATERIALS RECYCLING AND DISPOSAL

.1 All controllers and control devices shall be recycled in accordance with federal and provincial guidelines.

.2 All packaging and other disposable components of the work shall be recycled.

.3 Contractor shall provide all recycling bins and containers required for proper disposal. Contactor is not to use Owner's facilities for disposal of recyclable materials.

.4 Non-recyclable materials are to be disposed of in an environmentally responsible manner.

.5 Metals may be disposed of through delivery to scrap metal vendors. Contractors may keep any proceeds from metal disposal to offset any costs incurred in sorting and transportation of materials to scrap metal vendors.

.6 Clean-up work area as work progresses.

.7 Source separate materials to be reused/recycled into specified sort areas.

Schedule A: Waste Reduction

3.3 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

British Columbia	Ministry of Environment Lands and Parks 810 Blanshard Street, 4th Floor Victoria BC V8V 1X4	604-387-1161	604-356-6464
	Waste Reduction Commission Soils and Hazardous Waste 770 South Pacific Blvd, Suite 303 Vancouver BC V6B 5E7	604-660-9550	604-660-9596

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 74 11 – Cleaning.

.2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:

.1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.

.2 Request Consultant's inspection.

.2 Consultant's Inspection:

.1 Consultant and Contractor to inspect Work and identify defects and deficiencies.

.3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

.1 Work: completed and inspected for compliance with Contract Documents.

.2 Defects: corrected and deficiencies completed.

.3 Equipment and systems: tested, adjusted and balanced and fully operational.

.4 Certificates required by Electrical Inspection Branch: submitted.

.5 Operation of systems: demonstrated to Owner's personnel.

1.3 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11 – Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products - NOT USED

Part 3 Execution

3.1 FINAL FIELD REVIEW

.1 Submit request upon completion of the Work, in writing, to the Consultant for a Final Field Review of the completed mechanical and electrical work.

.2 The Contractor is to have qualified manpower present for final field review, with ladders and tools, to provide the Consultant with access to the Work and to demonstrate installations.

.3 Do not submit this written request until:

.1 A minimum of 95% of the value of the project is completed;

.2 Local electrical inspection has been completed and accepted; the Contractor is to submit to the Departmental Representative copies of the accepted electrical inspection forms that have been properly signed by the local, city or municipal electrical inspector;

.3 Deficiencies noted during previous field reviews have been completed;

.4 Air systems have been balanced and preliminary reports submitted to consultant

.5 Commissioning has been completed.

.6 The clean up is finished in every respect;

.7 Contractor has completed a review of the work and has provided the Consultant with a list of any deficiencies found;

.8 Extended warranty offered by manufacturers beyond one year (compressor, VSD, etc.) is outlined in a letter to the Department;

.9 Operations and Maintenance manuals have been submitted to consultant.

.4 Final field review will be conducted within approximately ten (10) business days of this request. Letter of acceptance or rejection along with a Field Review Report will be issued within approximately seven (7) business days of field review.

.5 The Consultant will perform only one field review of each area of the work upon the above request.

.6 Upon receipt of the Field Review Report, the Contractor will complete the deficiencies within 30 days and to notify the Consultant when the Work is 100% completed. Photographic documentation verifying completions of deficiencies and the deficiency report shall be submitted to the consultant. A field review of the areas of deficiency will then be conducted at the discretion of the Consultant. Should the Work not be completed to the satisfaction of the Departmental Representative or the Consultant and an additional field review is required, the costs for the Consultant will be paid by the Contractor. Costs will be based on time required at the Consultant's standard billing rates.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – ECMS General Requirements.

1.2 SUBMITTALS

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

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Revise content of submittal documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, three final hard copies and one soft, PDF file copy of operating and maintenance manuals.

1.3 AS-BUILT DRAWINGS

.1 Changes made during installation and before completion of the Work shall be documented by the Contractor to ensure that the changes are recorded as they occur; they are to be indicated by use of coloured lines and suitable notations on one complete set of Drawings set aside exclusively for this purpose.

.2 The Contractor shall submit an electronic copy of the As-Built Drawings in PDF format to the Departmental Representative after completely incorporating the revisions as above. These Drawings shall be clearly identified with the notation "Revised As-built" imprinted adjacent to the title block.

.3 A copy of the as-built drawings shall be saved on the Operator Workstation and accessible via an icon on the main graphic screen.

1.4 OPERATING AND MAINTENANCE MANUALS

.1 The existing Operating and Maintenance manuals shall be revised to include the changes made under this contract. Out of date and not applicable information shall be removed from the manual and new information shall be added to form a complete document for the Owner. Contents shall not include hand-written data. The contractor’s responsibility is limited to the updating of system information relative to the version upgrade.

.2 One copy of the Operating and Maintenance Manuals for the Control Systems shall be submitted in electronic format (pdf) to the Departmental Representative for acceptance before Substantial Completion.

1.5 CONTENTS - EACH VOLUME

.1 The O & M manual shall include as-built versions of the submittal product data.

.2 In addition to that required for the submittals, the O & M manual shall also include:

.1 Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.

.2 A listing and documentation of all custom software created using the programming language including the point database. One set of electronic media containing files of the software and database shall also be provided

.3 One set of electronic media containing files of all color-graphic screens created for the project.

.4 Complete original issue documentation, installation and maintenance information for all third-party hardware provided including computer equipment and sensors.

.5 Complete original issue of all software provided including operating systems, programming language, operator workstation software, and graphics software.

.6 Licenses, Guarantee, and Warrantee documents for all equipment and systems.

.7 Testing and Commissioning Reports and Checklists.

.8 Project Record Drawings - These shall be as-built versions of the submittal shop drawings.

.9 Customized description of graphic interface with instructions on how to start the graphics package, make setpoint changes, add or modify schedules, add or modify a trend, add, modify or acknowledge alarms (sample of required detail available during tender period).

.10 Description of systems controlled, system drawings, sequence of operation and schedules.

.11 Panel riser and panel by panel points list.

.12 Reduced floor plans showing equipment and sensor locations.

.13 Reduced shop drawings including wiring diagrams showing hardware interlocks.

.14 Record of Training.

.3 Review manual with the Departmental Representative operating staff or representatives to ensure a thorough understanding of each item of equipment and its operation.

.4 Should the Contractor thereafter amend the manuals, he shall promptly provide one copy of any such amendments to the Departmental Representative for acceptance. Upon acceptance by the Departmental Representative, the Contractor shall provide three copies of such amendments.

.5 Engineering, Installation and Maintenance Manual(s), which shall include descriptions on how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

.6 Operators Manual, which shall include Procedures for operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

1.6 FORMAT

.1 Organize data as instructional manual.

.2 Following acceptance by the Departmental Representative, submit three (3) complete sets of operating and maintenance instructions, bound in vinyl covered hard backed binder, 8

1/2" x 11" (210 mm x 297 mm) size, three-ring covers at completion, and before Substantial Completion of the Work. Contents of books shall not include hand-written data.

.3 When multiple binders are used, correlate the data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 USB Thumb drive with a copy of the Operating and Maintenance Manuals shall be provided in electronic format (Adobe pdf) and inserted in each of the O&M binders.

.10 A copy of the Operating and Maintenance Manual in Adobe pdf format shall be saved in the hard drive of the Operator Workstation.

1.7 WARRANTY

.1 At the end of the final start-up/testing and commissioning, if equipment and systems are operating satisfactorily to the Department and Departmental Representative, the Department shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.

.2 Labour & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures of upgrade components during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.

.3 The warranty shall provide all material, parts and labour, including labour provided on an emergency response basis outside of normal working hours. Labour shall include any related travel time and other related costs associated with providing the warranty service.

.4 The warranty shall cover all aspects of the control system upgrade provided under this contract, including control devices, transducers, and software.

.5 A detailed service report must be filed with the Departmental Representative after each warranty visit, detailing the work performed, time spent, devices replaced or repaired, and the personnel involved.

.6 Emergency calls during the warranty period shall be addressed by the Contractor within four (4) hours of notification. Service shall be available 24 hours per day, seven days a week. The Departmental Representative shall be provided an emergency phone number for contacting service personnel. The service call shall only be chargeable if inspection reveals any defect not directly covered under the terms of the specification.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section specifies roles and responsibilities of Commissioning Training.

1.2 TRAINEES

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

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

1.3 INSTRUCTORS

.1 Contractor shall 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, shutdown 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 shutdown of equipment they have certified installation, started up and carried out PV tests.

1.4 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 troubleshooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training 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 Base 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.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 4 hours in length.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,
.2 Coordination among instructors,
.3 Quality of training, training materials,

.2 Consultant, Commissioning Authority, and Commissioning Oversight Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructor including list of participants.

1.8 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.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.

.2 BMM - Building Management Manual.

.3 Cx - Commissioning.

.4 EMCS - Energy Monitoring and Control Systems.

.5 O&M - Operation and Maintenance.

.6 PI - Product Information.

.7 PV - Performance Verification.

.8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the BMM.

.3 Effectively train O&M staff.

.2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

.1 Section 01 91 13.13 - Commissioning Plan.

.2 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.

.3 Cx to be a line item of Contractor's cost breakdown.

.4 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Consultant, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review Contract Documents, confirm by writing to Consultant.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Consultant.

.7 Ensure systems have been cleaned thoroughly.

.8 Complete TAB procedures on systems, submit TAB reports to Consultant and Commissioning Authority for review and approval.

.9 Ensure "As-Built" system schematics are available.

.4 Inform Consultant and Commissioning Authority in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Consultant and Commissioning Authority before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit no later than 4 weeks after award of Contract:

.1 Name of Contractor's Cx Agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Consultant and Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Consultant and Commissioning Authority where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Consultant, Commissioning Authority, and Commissioning Oversight Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 Consultant and Commissioning Authority to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Consultant and Commissioning Authority.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 Construction Progress Schedule.

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16 07 Construction Progress Schedule and as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 As required, call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Commissioning Authority, who will record and distribute minutes.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Consultant and Commissioning Authority to witness of start-up and testing as required, and/or review report prepared by Contractor’s Cx Agent of start-up and testing results.

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

.1 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Commissioning Authority.

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.2 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.3 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from Consultant and Commissioning Authority after distinct phases have been completed and before commencing next phase.

.4 Document require tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Consultant. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

.3 If evaluation report concludes that major damage has occurred, Consultant shall reject equipment.

.1 Rejected equipment to be remove from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Commissioning Authority for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Consultant or Commissioning Authority to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit Consultant and Commissioning Authority for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

.1 Notify Consultant and Commissioning Authority at least 14 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Consultant and Commissioning Authority for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual or (if required, and accepted by Commissioning Authority) simulated operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Commissioning Authority to witness equipment start-ups (as required) and PV and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Consultant within 5 days of test and with Cx report.

1.23 EXTENT OF VERIFICATION

.1 Contractor or Contractor's Cx Agent to provide manpower and instrumentation to verify reported start-up and/or testing results, unless specified otherwise in other sections.

.2 Number and location to be at discretion of Consultant and/or Commissioning Authority.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Perform additional commissioning until results are acceptable to Consultant and Commissioning Authority.

1.24 REPEAT VERIFICATIONS

.1 Assume costs incurred by Consultant and/or Commissioning Authority for third and subsequent verifications where:

.1 Verification of reported results fail to receive Consultant, Commissioning Authority, and Commissioning Oversight Representative approval.

.2 Repetition of second verification again fails to receive approval.

.3 Consultant, Commissioning Authority, and Commissioning Oversight Representative deems Contractor's request for second verification was premature.

1.25 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.26 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Consultant, Commissioning Authority, and Commissioning Oversight Representative.

.2 Report problems, faults or defects affecting Cx to Consultant and Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with written approval from Consultant and Commissioning Authority.

1.27 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Consultant, Commissioning Authority, and Commissioning Oversight Representative.

1.28 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.29 TRAINING

.1 In accordance with Section 01 79 00.13 - Demonstration and Training for Building Commissioning.

1.30 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.31 OWNER'S PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Description of overall structure of Plan and roles and responsibilities of commissioning team.

1.2 REFERENCE STANDARDS

.1 American Water Works Association (AWWA)

.2 National Fire Protection Association (NFPA)

.1 NFPA-13-[02], Installation of Sprinkler Systems Handbook.

.2 NFPA-13-[02], Automatic Sprinkler Systems Handbook.

.3 NFPA-20-[03], Standard for the Installation of Stationary Fire Pumps for Fire Protection.

.3 Public Works and Government Services Canada (PWGSC)

.1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-[03].

.4 Underwriters' Laboratories of Canada (ULC)

1.3 GENERAL

.1 Provide a fully functional mechanical system:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance and operate consistently at peak efficiencies and within specified energy budgets under normal loads.

.2 Facility user and O&M personnel have been fully trained in aspects of installed systems.

.3 Optimized life cycle costs.

.4 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.

.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to O&M, process and administration of Cx.

.4 Describes process of verification of how built works meet Owner’s design requirements.

.5 Produces a complete functional system prior to issuance of Certificate of Occupancy.

.6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

.4 Acronyms:

.1 Cx - Commissioning.

.2 BMM - Building Management Manual.

.3 EMCS - Energy Monitoring and Control Systems.

.4 MSDS - Material Safety Data Sheets.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

.8 WHMIS - Workplace Hazardous Materials Information System.

.5 Commissioning terms used in this Section:

.1 Bumping: short term start-up to prove ability to start and prove correct rotation.

.2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 100% completed within 6 weeks of award of contract to take into account:

.1 Approved shop drawings and product data.

.2 Approved changes to contract.

.3 Contractor's project schedule.

.4 Cx schedule.

.5 Contractor's, sub-contractor's, suppliers' requirements.

.6 Project construction team's and Cx team's requirements.

.2 Submit completed Cx Plan to Consultant, Commissioning Authority, and Commissioning Oversight Representative and obtain written approval.

1.5 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

.2 Revise, refine and update every 3 months during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to Consultant, Commissioning Authority, and Commissioning Oversight Representative for review and obtain written approval.

.4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

.1 Commissioning Authority with oversight by Commissioning Oversight Representative to maintain overall responsibility for project commissioning coordination and is sole point of contact between members of commissioning team.

.2 Project Manager will select Cx Team consisting of following members:

.1 Commissioning Oversight Representative: ensures Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Responsible for providing oversight and quality assurance of the project commissioning activities and documentation.

.2 Maintains the overall responsibility for the project commissioning and ensures the performance and completion of commissioning in the delivery of a fully functional and operational project.

.2 Commissioning Authority is responsible for ensuring the following activities are completed:

.1 Organizing Cx.

.2 Monitoring construction Cx activities.

.3 Witnessing, certifying accuracy of reported results as required.

.4 Witnessing and certifying TAB and other tests as required.

.5 Ensuring implementation of final Cx Plan.

.6 Performing verification of performance of installed systems and equipment.

.7 Implementation of Training Plan.

.3 Construction Team: contractor, subcontractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:

.1 Equipment start-up forms.

.2 Testing.

.3 TAB.

.4 Performance of Cx activities.

.5 Delivery of training and Cx documentation.

.6 Assigning one person as point of contact with Consultant and Commissioning Authority for administrative and coordination purposes.

.4 Contractor's Cx Agent implements specified Cx activities including:

.1 Demonstrations.

.2 Training.

.3 Testing.

.4 Preparation, submission of equipment start-up forms and test reports.

.5 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility.

.2 Day-To-Day operation and maintenance of facility.

1.7 CX PARTICIPANTS

.1 Employ the following Cx participants to verify performance of equipment and systems:

.1 Installation contractor/subcontractor:

.1 Equipment and systems except as noted.

.2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.

.1 To include performance verification.

.3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.

.4 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

.2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:

.1 Modify ventilation rates to meet changes in off-gassing.

.2 Changes to heating or cooling loads beyond scope of EMCS.

.3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.

.4 Redistribution of electrical services.

.5 Modifications of fire alarm systems.

.6 Modifications to voice communications systems.

.5 Provide names of participants to Commissioning Authority and details of instruments and procedures to be followed for Cx 2 months prior to starting date of Cx for review and approval.

1.8 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:

.1 Plumbing systems:

.1 water drainage systems.

.2 HVAC and exhaust systems:

.1 HVAC systems.

.2 General exhaust systems.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.

.2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.10 DELIVERABLES RELATING TO THE CX PROCESS

.1 General:

.1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems.

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Cx Specifications.

.2 Start-up, pre-Cx activities and documentation for systems, and equipment.

.3 Completed equipment start-up forms.

.4 Completed product information (PI) report forms.

.5 Completed performance verification (PV) report forms.

.6 Results of Performance Verification Tests and Inspections.

.7 Description of Cx activities and documentation.

.8 Description of Cx of integrated systems and documentation.

.9 Tests witnessed by Commissioning Authority.

.10 Training Plans.

.11 Cx Reports.

.12 Prescribed activities during warranty period.

.4 Commissioning Authority to witness as required and certify completion of testing and testing results reports.

.5 Consultant to participate as required.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by Consultant prior to permission to start up and rectification of deficiencies to Consultant's satisfaction.

.2 Contractor or Contractor's Cx Agent to use approved check lists.

.3 Commissioning Authority may monitor some of these pre-start-up inspections.

.4 Include completed documentation with Cx report.

.5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. Commissioning Authority may monitor inspections and tests.

.6 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:

.1 Plumbing systems:

.1 Test water supply and drainage systems.

.2 Complete pre-start-up checks and complete relevant documentation.

.2 HVAC equipment and systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 At this time, complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.

.3 EMCS:

.1 EMCS trending to be available as supporting documentation for performance verification.

.2 Perform point-by-point testing in parallel with start-up.

.3 Carry out point-by-point verification.

.4 Perform performance verification testing with Commissioning Authority.

.5 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".

.3 Pre-Cx activities - LIFE SAFETY SYSTEMS

.1 Include equipment and systems identified above.

.2 Include but not limited to the following life safety systems:

.1 Emergency lighting and exit lighting.

.2 Domestic hot water temperature verification.

.3 Stairwell pressurization testing.

.4 Fire alarm and related systems (eg. HVAC equipment interlocks and/or elevator recall functions) verification.

.5 Plumbing backflow prevention testing and test reports.

.6 Sprinkler systems sign-off by qualified professional.

.7 Fire damper testing and test reports.

.8 Minimum outdoor air verification.

.3 Reports of test results to be certified by Consultant.

.4 Pre-Cx activities - ELECTRICAL:

.1 Low voltage distribution systems under 750 V.

.2 Low voltage systems: these include:

.1 Clock, communications, low voltage lighting control systems and data communications systems.

.2 Special systems such as Simultaneous Translation systems, MPs Call systems, Messenger Call systems, Division Bell systems.

1.12 START-UP

.1 Start-up components, equipment and systems.

.2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:

.1 HVAC systems (heating, ventilating and air conditioning systems including hydronic systems and equipment).

.2 Plumbing systems.

.3 Control systems.

.4 Electrical distribution systems.

.3 Commissioning Authority to monitor some of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Commissioning Authority and Consultant.

.4 Performance Verification (PV):

.1 Contractor’s Cx Agent, DDC Representative, and Commissioning Authority to perform.

.1 Repeat when necessary until results are acceptable to Commissioning Authority and Consultant.

.2 Use procedures modified generic procedures to suit project requirements.

.3 Commissioning Authority to witness as required and certify completion of reported results of equipment start-ups.

.4 Contractor’s Cx Agent, DDC Representative, and Commissioning Authority to perform PV testing using approved PV forms.

.5 Commissioning Authority to approve completed PV reports and provide to Consultant.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx using procedures developed by Commissioning Authority and Consultant and approved by Commissioning Oversight Representative.

1.14 EQUIPMENT START-UP CHECK LISTS

.1 Refer to Section 01 91 13.16 Commissioning Forms.

1.15 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Refer to Section 01 91 13.16 Commissioning Forms.

1.16 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 13.16 Commissioning Forms.

1.17 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Complete Cx of occupancy (ie. life safety) equipment and systems in areas before building is occupied.

1.18 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Commissioning Authority for review and approval same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Contractor's Cx Agents' credentials: 60 days before start of Cx.

.2 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.3 Notification of intention to start TAB: 21 days before start of TAB.

.4 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.5 Notification of intention to start Cx: 1 month before start of Cx.

.6 Implementation of training plans.

.7 Equipment start-up forms: immediately upon successful completion of Cx.

.8 Dates of planned system infrastructure testing, filling, flushing, cleaning, pressure tests, etc.

.9 Dates of planned equipment start-ups including manufacturer performed start-ups.

.10 Dates of planned TAB.

.11 Dates of final Controls complete and end-to-ends provided.

.12 Dates of scheduled period for performance verification testing.

.13 Dates of release of draft and final Operation and Maintenance Manual.

.14 Dates of planned training sessions.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx Agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.19 CX REPORTS

.1 Submit reports of equipment start-up tests, witnessed as required and certified by Commissioning Authority to Consultant who will verify reported results.

.2 Submit completed and certified PV reports.

.3 Before reports are accepted, reported results to be subject to verification by Consultant.

1.20 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC systems.

.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

1.21 TRAINING PLANS

.1 Refer to Section 01 79 00.13 Demonstration and Training for Building Commissioning.

1.22 FINAL SETTINGS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment, system and integrated system.

1.2 EQUIPMENT START-UP CHECK LISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's equipment start-up check lists are acceptable for use. As deemed necessary by Consultant and/or Commissioning Authority supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment start-up. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Consultant and Commissioning Authority. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.

.5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Consultant, Commissioning Authority, and Commissioning Oversight Representative approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Consultant, Commissioning Authority, and Commissioning Oversight Representative approval.

1.5 SAMPLES OF COMMISSIONING FORMS

.1 Commissioning Authority will develop and provide to Contractor required project-specific equipment start-up and PV forms in electronic format complete with specification data.

.2 Revise items on Commissioning forms to suit project requirements.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required but are not available from Consultant or Commissioning Authority develop appropriate verification forms and submit to Consultant and Commissioning Authority for approval prior to use.

.1 Additional commissioning forms to be in same format as provided by Consultant and/or Commissioning Authority.

1.7 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Commissioning Authority provides Contractor project-specific Commissioning forms.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Equipment start-up forms to bear signatures of recording technician and reviewed and signed off by Contractor or Contractor's Cx Agent.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Consultant and Commissioning Authority with originals of completed forms.

.12 Maintain copy on site during start-up, testing and commissioning period.

1.8 LANGUAGE

.1 To suit the language profile of the awarded contract, English is to be used.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.2 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.3 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.4 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.2 Reference Standards:

.1 Canadian Environmental Protection Act,1999 (CEPA 1999)

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) [1992], (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada-2005.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with Owner and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and waste in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.5 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

1.3 EXISTING CONDITIONS

.1 The Owner is not aware of any asbestos hazard within the scope of work for this project. This is not a guarantee that there is no asbestos present within the proposed work area.

.2 Any reports and information pertaining to ACMs within the facility will be provided on request.

.3 Notify the Owner of material discovered during Work and not apparent from report. Do not disturb such material. Testing and subsequent abetment as required will be carried at the owner’s expense.

Part 2 Products

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material required to perform Work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 CLEANING

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

.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Seismic restraint systems for statically supported and vibration isolated equipment and systems; including plumbing equipment and pipes, mechanical equipment pipes and ducts, equipment and systems, both vibration isolated and statically supported.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA G40.20/G40.21-[04], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Building Code of Canada (NBC)

1.3 DEFINITIONS

.1 SRS: acronym for Seismic Restraint System.

1.4 SYSTEM DESCRIPTION

.1 SRS fully integrated into, and compatible with:

.1 Noise and vibration controls specified elsewhere.

.2 Structural, mechanical, electrical design of project.

.2 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.3 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia.

1.5 SUBMITTALS

.1 Submit shop drawings including details of attachment to the structure for the roof mounted equipment. Attachment details to the structure to be approved by a BC Registered Professional Engineer.

.2 Submit Engineering Schedules signed and sealed by a structural engineer registered in the Province of BC for the seismic securement of mechanical equipment and piping installed in the upgrade.

.3 The seismic design, installation and certification shall be the responsibility of the Mechanical Contractor.

Part 2 Products

2.1 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to RC structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power-driven anchors not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

2.2 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in every direction.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.3 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

2.4 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Use elastomer materials or similar, to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

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 Attachment points and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.

.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services.

.4 Miscellaneous equipment not vibration-isolated:

.1 Bolt through house-keeping pad to structure.

.5 Co-ordinate connections with other disciplines.

3.3 FIELD QUALITY CONTROL

.1 Inspection and Certification:

.1 SRS: inspected and certified by Seismic Engineer upon completion of installation.

.2 Provide written report to Consultant with certificate of compliance.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Ductwork: Section 23 31 13

.2 Ductwork Accessories: Section 23 33 00

1.2 REFERENCE DOCUMENTS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).

.2 ASHRAE 52.2-2007 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

.3 Canada Green Building Council (CaGBC)

.4 LEED Canada 2009 Rating System - LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: www.cagbc.org]

.5 Sheet Metal and Air Conditioning National Contractors Association (SMACNA)

.6 SMACNA IAQ Guideline for Occupied Building Under Construction

1.3 QUALITY ASSURANCE

.1 The Department may hire an independent agency to review duct cleaning procedures prior to starting work and perform spot check review of work to determine that duct cleaning has been effectively executed.

1.4 SUBMITTALS

.1 Perform duct system cleaning using a firm specializing in this type of work. Submit the following information prior to commencing work:

.2 Name of the superintendent that will be responsible for executing the work and his experience with projects of this scope.

.3 Submit an outline of the work scope for each air handling system with procedures, equipment, materials, and schedule prior to commencing work.

.4 Submit a Certificate of Completion stating that duct cleaning has been completed as specified in this section.

1.5 DEFINITIONS

.1 Air system: includes central equipment; supply, return and exhaust fans, coils, dampers, turning vanes, grilles, diffusers, high, medium and low-pressure ductwork (supply, return and exhaust) that is associated with an air handling system.

1.6 PROTECTION

.1 Protect furniture, equipment and flooring in close proximity to the work area with clean protective coverings.

.2 Take precautions to ensure that dust and debris do not spread outside of duct system during the cleaning process.

Part 2 Products

2.1 MATERIALS

.1 NOT USED

2.2 ACCESS DOORS

.1 NOT USED.

Part 3 Execution

3.1 DUCT SYSTEM CLEANING

.1 Commence duct system cleaning after completion of demolition and ductwork installation and before air handling systems are started.

.2 Clean the air systems to remove all visible particulates:

.3 Install temporary filters:

.4 Within the office areas, clean all new and re-used existing ductwork and plenums with high power suction equipment.

.5 Do not use mechanical brushes on acoustic lined ductwork.

.6 Clean diffusers and grilles that are to be re-used and re-balanced.

3.2 DUCT SYSTEM DISINFECTION

.1 NOT USED

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 02 81 01 – Hazardous Materials

.3 Section 13 48 00 – Seismic Control

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

.3 National Fire Code of Canada (NFCC 2005)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Store and handle in accordance with the manufacturer recommendations.

Part 2 PRODUCTS

2.1 MATERIAL

.1 Fire Stopping: in accordance with Fire Stopping requirements

.1 Contractor to provide shop drawings of the proposed fire stopping for review.

2.2 PIPING

.1 All pipe used in, hot water heating systems shall be standard weight Schedule 40 black steel pipe, ASTM Specification A53, Grade B.

.2 All piping size 50 mm (2”) and smaller shall be screwed joints and all piping size 65 mm (2½”) and larger shall be welded.

.3 All cold-water supply piping shall be certified and labelled type L hard copper tubing to ASTM B88, latest edition. Fittings shall be streamline wrought copper solder joint fittings to ANSI B16.22. All joints shall be made up using 95/5 solder.

.4 All threads shall be standard, clean cut, and tapered to ANSI B1.20.1. Threaded joints shall be made up using approved type thread lubricant applied to the male thread only. Thread lubricant shall be suitable for the service and temperature and shall be a type that does not set-up hard under service.

.5 Connections to heating elements and equipment shall be made using the correct tappings as recommended by the manufacturer or as detailed on the drawings.

.6 Where it is necessary to make solder joint connections to copper tubing, copper wall fin, or copper equipment connections, all joints shall be made up using 95/5 solder. Where it is necessary to use copper tubing in connections, all copper tubing used shall be certified and labelled type L hard copper tubing to ASTM B88, latest edition. Fitting shall be streamline wrought copper solder joint fittings to ANSI B16.22.

.7 When it is necessary to make new connections into existing piping it shall be the responsibility of the Contractor to trace the existing piping and correctly determine which of the existing lines is supply and which is return and to make all new connections accordingly.

.8 All piping drawings are schematic only. The Contractor shall co-ordinate his work with that of other trades and locate his piping runs and set his elevations with due regards to adjacent services, equipment, structure, and architectural intent. He shall take into consideration grading, draining, insulation, and thermal expansion and contraction. All piping shall be located to permit access and/or removal of all equipment and its internal elements.

2.3 WELDING

.1 All welding shall be performed in accordance with the requirements of the B.C. Boiler Inspection Branch and ASME B31.1, Power Piping. Welding shall only be carried out by skilled pipe welders who have passed B.C. Boiler Inspection pipe welding test and who hold current welding certificates for the work being performed.

.2 Pipe size 50 mm (2") and smaller shall be oxyacetylene gas welded. Pipe size 65 mm (2½") and larger shall be electric arc welded. All welds shall be multiple pass. The ends of all pipe to be joined by welding shall be machine cut, properly and cleanly bevelled, and properly spaced to ensure the uniformity of the weld throughout the entire joint.

.3 Welding is approved in the following areas:

.1 Mechanical Rooms

2.4 GROOVED END PIPE AND FITTINGS

.1 The use of grooved end pipe, fittings, and couplings is not permitted on this project.

2.5 EXPANSION CONTROL

.1 All piping shall be installed so that it will in no way be strained or distorted by expansion. Anchors and expansion loops shall be provided where necessary to protect equipment and piping and regulate expansion.

.2 Anchors and guides shall be installed wherever necessary to limit expansion and protect equipment. If on-the-job circumstances require additional changes of direction or additional expansion joints, loops, or guides, this Division shall be responsible for furnishing and installing same at no extra cost.

.3 Pipe alignment guides shall be Flexonics or approved equal. Guides shall be securely anchored in place to the building structure. They shall be installed as per the manufacturers' instructions. Guides shall be suitable for the pipe insulation thickness.

2.6 DRAINS

.1 All piping drains shall be fitted with 20 mm (¾") bronze screwed ball type drain valves complete with lever handle, hose outlet, hose cap and chain.

.2 All auxiliary drains in convectors unit heaters, etc., shall be fitted with 20 mm (¾") bronze screwed hose bibs with wheel handle, hose outlet, and brass hose cap with chain.

2.7 REFRIGERANT PIPING

.1 Refrigerant piping shall be supplied and installed in accordance with the requirements and recommendations of CSA Standard B52, Mechanical Refrigeration Code (latest edition), ASHRAE Refrigeration Handbook and ASME Standard B31.5, Refrigeration Piping (latest edition).

.2 All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. No material shall be used that will deteriorate because of the refrigerant, the oil, or their combination in the presence of the air or moisture.

.3 The design, construction and testing of refrigerant piping and the registration of fittings shall conform to all requirements of CSA Standard B52 (latest edition). Conformance to these requirements and to those of the regulatory authorities requires that the applicable requirements for welding procedures, brazing procedures, quality control and other related requirements shall be followed.

.4 The design pressure selected should exceed maximum pressures attained under any anticipated normal operating conditions, including conditions created by reasonable fouling of heat-exchange surfaces.

.5 Unprotected, hard-drawn copper tubing used for refrigerant piping erected on the premises shall conform to ASTM Standard B88, Types K or L. Copper tubing with an outside diameter of 6 mm (¼ in.) shall have a nominal wall thickness of not less than 0.76 mm (0.030 in.).

.6 Unprotected, soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes larger than 35 mm (1 3/8 in.) outside diameter. It shall conform to ASTM Standard B280. Minimum nominal wall thickness of unprotected, soft, annealed copper tubing shall be as given in CSA Standard B52.

.7 Rigid or flexible metal enclosures shall be provided for soft, annealed copper tubing used for piping erected on the premises and containing any refrigerant other than a Group A1 refrigerant. However, no enclosures shall be required for connections between a condensing unit and the nearest risers box, provided such connections do not exceed 1.8 m (6 ft.) in length.

.8 Joints on copper tubing used in refrigerating systems shall be brazed joints. Soldered joints shall not be used in such refrigerating systems.

.9 All systems shall have provisions to handle safely the refrigerant charge for servicing purposes without venting the charge to atmosphere. This may include properly located stop valves, liquid transfer valves, and refrigerant storage tanks required for the safe transfer, discharge, and disposal of the charge, without venting the charge to the atmosphere.

.10 All systems containing more than 3 kg (6.6 lb) of refrigerant shall have stop valves installed at the following locations:

.1 on each inlet of each compressor, compressor unit, or condensing unit; and

.2 one each discharge outlet of each compressor, compressor unit, or condensing unit, and on each liquid receiver.

.11 Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge or are equipped with provisions for pumpout of the refrigerant, or self-contained systems shall not require stop valves installed at the above locations.

.12 Systems containing more than 50 kg (110 lb) of refrigerant shall have stop valves installed at the following locations:

.1 The suction inlet of each compressor, compressor unit, or condensing unit;

.2 The discharge outlet of each compressor, compressor unit, or condensing unit;

.3 The inlet of each liquid receiver, except for self-contained systems or where the receiver is an integral part of the condenser or condensing unit;

.4 The outlet of each liquid receiver; and

.5 The inlet and outlet of condensers when more than one condenser is used in parallel in the system

.13 Stop valves used with soft, annealed copper tubing or hard-drawn copper tubing 22 mm (7/8 in.) in outside diameter or smaller shall be securely mounted, independent of tubing fastenings or supports.

.14 Joints and all refrigerant-containing parts of a refrigerating system located in an air duct carrying conditioned air to and from a human-occupied space shall be constructed to withstand a temperature of 427°F (800°C) without leakage into the air stream.

.15 Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection at the discretion of the regulatory authority.

.16 Refrigerant piping crossing an open space that affords passageway in any building shall be not less than 2.3 m (7½ ft) above the floor unless against the ceiling of such a space.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 PIPING

.1 All piping runs shall be fabricated in a neat and workmanlike manner, all grades shall be true and even, and all vertical piping shall be plumb.

.2 Hot water heating and closed-circuit piping systems, in general, shall pitch upwards in the direction of flow towards air vents with a uniform grade of 25 mm (1") in 6000 mm (20'-0"). Steam mains shall pitch downwards in the direction of flow towards drip points with a uniform grade of 25 mm (1") in 6000 mm (20'-0"). Condensate return lines shall pitch downwards in the direction of flow with a uniform grade of 25 mm (1:) in 4500 m (15'-0").

.3 All piping shall be installed so that all water can be completely drained.

.4 Runouts and branch lines to radiation, equipment, risers, stubs, etc., shall have a uniform grade of 25 mm (1") in 600 mm (24"). Water branches shall be taken off the top or bottom of the mains, as required, at an angle of 45° or 90°.

.5 Each runout or branch shall be made up with swing joints and shall contain at least three elbows for flexibility. The base of each riser or stub, and the top of each drop shall be made up with a two-elbow swing joint.

.6 All piping at pumps, coils, equipment, etc., shall be supported independent of the equipment and shall be anchored in close proximity to the equipment to prevent strain or shock being transmitted to the equipment.

3.3 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

.4 Install flushing bypasses to sensitive pieces of equipment and as directed my manufacturers recommendations.

3.4 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and as indicated without interrupting operation of other system, equipment, components.

3.5 DRAINS

.1 Install 20 mm (¾") hose drains at each low point in the system to permit complete drainage. Access panels shall be provided to all drain valves located concealed in walls or ceilings.

.2 All drains, blow offs, automatic air vents and overflow lines shall be piped to floor drains.

.3 Condensate drains from cooling coil drain pans shall be trapped and piped from the drip pan to the nearest accessible drain or as noted on the drawings. Drains shall be complete with cleanouts as required.

.4 No drain or overflow shall discharge onto any floor.

3.6 AIR VENTS

.1 Install auto air vents to CSA B139 at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible and next to the floor drain.

3.7 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.8 VIBRATION INSULATION SLEEVES

.1 Use rubber made expansion joints for major pumps and chillers as shown.

.2 Contractor to provide shop drawings for review.

3.9 PIPEWORK INSTALLATION

.1 Install pipework to CSA B139.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 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.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible.

.12 Ream pipes remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion installed in the hot and chilled water pipes. Natural expansion on the L - bows is recommended strategy. Contractor to provide shop drawings of the thermal expansion.

.15 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Use gate, ball valves at branch take-offs for isolating purposes except where specified.

.16 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with upward flow and as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.10 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.11 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one-piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.12 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

.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.

3.13 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush heating systems, after chemical cleaning, with the domestic water. First flush shall be to remove debris and bigger particles from the system without operation of the pumps. The second/third flush shall be with system pumps operational at maximum speed. Repeat the process until there will be no mechanical particles in the water. Clean strainers and dirt separators after each step of the flushing.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.14 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work. All new section of piping and all installations in the mechanical rooms shall be pressure tested.

.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 Consultant.

.6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Consultant.

3.15 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval by Consultant 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.16 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

.1 23 05 05 Installation of Pipework

Part 2 PRODUCTS

2.1 PIPING

.1 Install ports per 23 05 05

Part 3 EXECUTION

3.1 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush heating systems after chemical cleaning, with the domestic water. First flush shall be to remove debris and bigger particles from the system without operation of the pumps. The second/third flush shall be with system pumps operational at maximum speed. Repeat the process until there will be no mechanical particles in the water. Clean strainers and dirt separators after each step of the flushing.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

.3 Permits, the contractor shall obtain and manage any permits that are required to release or dispose of water, fluids and chemicals, that are used in the flushing and cleaning process.

.4 Wetted pipework should not be left with raw water within, for longer than 48 hours.

3.2 Static Flush:

.1 Once the pressure testing of a system is completed and accepted by the consultant, the system will be filled with equipment isolated and flushing bypasses open.

.2 Fill the system with clean city water, through the flushing ports located up stream of the circulation pumps sets as indicated on the drawings.

.3 Drain the system through the flushing ports to draw out any light debris under gravity.

.4 Check system dirt pockets and strainers for debris. Install temporary filter screens as necessary.

3.3 Dynamic Flush:

.1 Fill the system with clean city water, through the flushing ports located up stream of the circulation pumps sets as indicated on the drawings.

.2 Vent system of air from highpoints.

.3 Close secondary loop valves.

.4 Complete pump start-up confirm rotation and speed drive operation in manual mode.

.5 Connect the flushing port closest to the pump intake to the city water. Connect the flushing port furthest from the pump intake to drain, via a flexible hose.

.6 Ensure that the primary loop circuit is open.

.7 Open the city water isolation valve to the system.

.8 Open the drain valve to the system to maintain operating system static pressure.

.9 Start system pumps at minimum speed, ramp up the pumps to achieve flushing velocities through the primary pipework. Adjust the discharge flushing port valve to maintain system static pressure and avoid potential pump cavitation.

.10 Run flushing configuration until the discharge water is running clear.

.11 Systematically alter the valve configurations of the system to run flushing velocity water through circuits of the entire system in a methodical manner.

.12 Run each flushing configuration until the discharge water is running clear.

.13 All items of plant which are sensitive to sediment must remain valved-off and bypassed throughout the flushing procedure.

.14 All items which are sensitive to high water velocity or debris must be considered and removed throughout the flushing procedure. (For example, insertion flow gauges, insertion temperature probes and flow switches)

.15 Care should be taken to ensure that pumps are not allowed to operate against a closed head for prolonged periods. The situation should be avoided whenever possible.

.16 Record velocities in each major pipe loop.

.17 Check and clean dirt pockets and strainers for debris as required and at the completion of the dynamic flush.

.18 Chemical treatment shall be commenced within 48 hours of the completion of the dynamic flush.

3.4 Chemical Flush:

.1 Chemical cleaning of the system should always be the responsibility of the appointed chemical cleaning specialist sub-contractor. However, in order to ensure that the chemical clean is successful, the installing contractor must be prepared to commit resources to assist with the process. In particular the installer will need to be aware of system conditions which must be maintained during the clean.

.2 It is recognized that for some chemical cleaning applications, that a certain minimum temperature may be required to be maintained during the chemical flushing process.

.3 Introduce cleaning chemicals to the system. Monitor the system chemical dilution with the guidance of the chemical cleaning specialist.

.4 As in the dynamic flushing methodology, strategically alter the valve configurations to allow elevated velocities to ensure the even and total dispersion of the chemical dilution, throughout the system being treated.

.5 Maintain system flow either continuously or intermittently (during supervised site and system operational times) through the duration of the chemical treatment period.

.6 Determine the active period of the chemical treatment with the guidance of the chemical treatment specialist. Inform the Departmental Representative of the dilution, treatment period duration and total dissolved solid results that were recorded.

.7 Ensure chemical dilution, acceptable solution discharge methods and permits.

.8 After acceptance of the results, dynamically flush out the chemical in the same manner as 3.14.6. Continue flush until discharge water is equivalent to city water being introduced.

.9 Received and compile for the project team, all reports from the flushing specialist. Submit with commissioning paperwork as received.

3.5 Inhibitor and Treatment to System Handover:

.1 Commence immediately after completion of the chemical flush.

.2 Open expansion tank to the system, commission unit with pressure checks and set system make up PRV.

.3 Introduce inhibitor chemicals to the system. Monitor the system chemical dilution with the guidance of the chemical cleaning specialist.

.4 As in the dynamic flushing methodology, strategically alter the valve configurations to allow elevated velocities to ensure the even and total dispersion of the chemical dilution, throughout the system being treated.

.5 Back flush and bleed all terminal units with inhibited solution.

.6 Review inhibitor chemical dilution and adjust with the guidance of the flushing specialist.

.7 Maintain system flow either continuously or intermittently (during supervised site and system operational times) through the duration of the chemical treatment period.

.8 After 7 days, review inhibitor chemical dilution and adjust with the guidance of the flushing specialist.

.9 Review, on a monthly basis, inhibitor chemical dilution and adjust with for two months after initial treatment. If any items are found to be out of tolerances, the system is to be review in 1 week and then resumed monthly if all is well. Samples are to be taken from differing drain ports through the system to ensure a continued chemical dilution quality throughout the system.

.10 Received and compile for the project team, all reports from the flushing specialist. Submit with commissioning paperwork as received.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit [two] copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

2.3 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW [10 HP]: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW [10 HP] and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 38 mm dia holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

Part 3 Execution

3.1 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 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.3 Section 23 05 53.01 - Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-01, 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.

1.4 SUBMITTALS

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

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Syphons.

.5 Wells.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 ASME B40.200.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 THERMOMETERS

.1 Industrial, variable angle type, aluminum case, glass front, 1% midscale accuracy, liquid filled, 125 mm scale length: to CAN/CGSB14.4 black letters with white background, dual temperature scale.

2.5 PRESSURE GAUGES

.1 Industrial, oil filled, 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketted pressure relief back with solid front.

.4 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 DIRECT READING 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 Water Heating heat pumps

.2 Storage tanks.

.3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps and across heat pump HP-HW.

.2 Upstream and downstream of PRV's.

.3 In other locations as indicated.

.2 Install pressure gauge test cocks and single pressure gauge for each equipment differential piped to test cocks.

.3 Install gauge cocks for balancing purposes, elsewhere as indicated.

.4 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International

.1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.2 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends to ANSI/ASME B16.18.

.3 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: non-asbestos.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Handwheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: handwheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.

.3 Operator: handwheel lockshield.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: handwheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed union bonnet.

.2 Operator: handwheel.

.4 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel.

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel lockshield.

.4 NPS 2 and under, plug disc, Class 150, screwed ends:

.1 Body and bonnet: union bonnet.

.2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.

.3 Operator: handwheel.

.5 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

.3 Operator: handwheel.

.5 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:

.1 Body: with integral seat, union bonnet ring with hex shoulders, cap.

.2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.6 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty to be used in vertical arrangement.

.6 Seat: regrindable.

.7 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125, 860 kPa.

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.8 Butterfly Valves:

.1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.

.1 Body: cast bronze, with copper-tube dimensioned grooved ends.

.2 Disc: elastomer coated ductile iron with integrally cast stem.

.3 Operator: lever.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 23 05 05 Installation of Pipework.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

- .1 ASTM A49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
- .2 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .3 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
- .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.
- .7 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.2 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

- .1 MSS SP-61-03, Pressure Testing of Steel Valves.
- .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS SP-82-1992, Valve Pressure Testing Methods.
- .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

- .1 Provide drawings stamped and signed by professional engineer registered or licensed in Canada.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: ductile iron to ASTM A536 Grade 65-45-12.

.2 Connections: flanged ends plain face to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze iron trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62.

.3 Seat rings: renewable bronze to ASTM B62, screwed into body.

.4 Stem: bronze to ASTM B62.

.5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.

.6 Seat: integral with body.

.7 Stem: wrought steel.

.8 Operator: handwheel.

2.3 UNDERWRITERS APPROVED GATE VALVE

.1 NPS 2 1/2 - 14, OS&Y:

.1 Approvals: UL and FM approved for fire service.

.2 UL and FM Label: on valve yoke.

.3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B) ductile iron to ASTM A536 Grade 65-45-12.

.4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.

.5 Packing gland: bronze.

.6 Stem: manganese bronze. Diameter to ULC C-262 (B). Brass, ASTM B16.

.7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).

.8 Bosses for bypass valve, drain on NPS 4 and over.

.9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.

.10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.

.11 Pressure rating:

.1 NPS 2-1/2 - 12: 1.7 Mpa CWP.

.2 NPS 14-1.2: 1.2 MPa CWP.

.12 Operator: handwheel.

.13 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves - Bronze.

2.4 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860 kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: handwheel.

.8 Bypass: complete with union and NPS gate globe valve as Section 23 05 23.01 - Valves - Bronze.

2.5 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

2.6 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: cast iron to ASTM A126 Class B ductile iron ASTM A536 Grade 65-45-12.

.2 NPS 18 and over: cast iron to ASTM A126 Class C.

.2 Ratings:

.1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.

.2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.

.3 NPS 18 and over: 1.03 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 6: bronze to ASTM B62 stainless steel type 316.

.2 NPS 8 and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Hinge pin, bushings: renewable bronze to ASTM B62 stainless steel.

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: cast iron, integral with body.

.8 Hinge pin: exelloy; bushings: malleable iron.

.9 Identification tag: fastened to cover.

.10 Hinge: galvanized malleable iron stainless steel.

2.7 SILENT CHECK VALVES

.1 Construction:

.1 Body: malleable iron with integral seat.

.2 Pressure rating: Class 125, WP = 860 kPa.

.3 Connections: grooved ends.

.4 Disc: bronze or stainless steel renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Stainless steel spring, heavy duty required on vertical arrangement.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

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

.2 Clean installed products in accordance to manufacturer's recommendation.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

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 A307-07b, 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 SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.2 PERFORMANCE REQUIREMENTS

.1 Design supports and hangers to withstand seismic loads.

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 SP58.

.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 SP58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.

.2 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed, FM approved to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies:

.2 Steel brackets: Sway braces for seismic restraint systems:

.6 Hanger rods: threaded rod material to MSS SP58:

.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 rod.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel black.....

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on Riser Piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis Plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: to BC Plumbing Code authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: to CSA B149.1

.1 Horizontal:

.1 up to NPS 15mm (½"): every 2.0 m (6')

.2 20mm to 25 mm (¾ to 1"): every 2.5m (8')

.3 32mm to 65 mm (1-1/4" to 2 ½"): every 3.0 m (10')

.4 75mm to 100mm (3" to 4"): every 5.0 m (15')

.5 125mm to 200mm (5" to 8"): every 6.0 m (20').

.2 Vertical:

.1 Every floor but not less than 125% of horizontal spacing

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Within 300 mm of each elbow.

.6 Per the following table:

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.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of **new** piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-05, 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.

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)
3	13 x 75	1-2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Equipment specified in the mechanical schedules: use size # 7.

.5 Identification for Safety or Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 In all areas:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #3.

.3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Consultant.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural Gas: Painted yellow with labeling per CSA/CGA B149.1 and authority having jurisdiction.

.2 Sprinklers: to NFPA 13.

.3 ANSI A.31

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.3 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.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.5 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.6 Colours and Legends:

.1 Where not listed, obtain direction from Consultant.

.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	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 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.

3.3 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.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in service rooms, equipment rooms ceiling spaces 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 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 At beginning and end points of each run and at each piece of equipment in run.

.7 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.

.8 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 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 Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 SCOPE OF WORK

.1 Conduct the following system measurement and balancing as indicated on the drawings across the following systems:

- .1 Air systems:
  - .1 Indoor heat pumps and associated air terminals.
  - .2 Make up air handling system AHU-3 and associated air distribution systems and air terminals.
  - .3 Paint room exhaust fans.
  - .4 Volume control dampers installed and open.
  - .5 Minimum outdoor air setpoints for controls dampers.
  - .6 Access doors, installed, closed.
  - .7 Outlets installed; volume control dampers open.
- .2 Water Balancing
  - .1 Water heating heat pump,
  - .2 Heating water circulation Pumps
  - .3 Unit heater water flow
  - .4 Control valves
  - .5 Tanks

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Departmental Representative within 30 days of award of contract.

.2 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

- .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
- .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998 Sheet Metal and Air Conditioning Contractors' National Association

(SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.3 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.4 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.6 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and 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 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, and caulking.

.5 Pressure, leakage, other tests as per specifications.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Access doors, installed, closed.

.7 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 All HVAC systems: plus or minus 10%.

.2 Hydronic systems: plus or minus 5%.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments 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 6 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

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 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 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC. TAB current member in good standing of AABC qualified to standards of AABC.

.2 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.

.3 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.

.4 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.

.5 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Quality assurance: as for air systems specified this section.

.2 Air Handling units and Exhaust systems

.1 Contractor to include for balancing the HVAC systems served by existing and new units.

.2 Contractor to include for preliminary air flow measurements and verification of the AHU air flow and static pressure.

.3 For the new hot water pumps, boilers, and bypass valves.

.4 Balancing of the distribution systems shall be conducted with all motorized valves in 100% open position unless noted otherwise.

.5 Include for review and inspection of the valves prior to TAB.

.6 Utilize flow control valves and pump curves to calculate pump flows

.7 Contractor to include for preliminary air flow measurements and review of the results with the Departmental Representative.

.8 Final balancing instruction will be provided by the after preliminary balancing report review.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The mechanical equipment schedules are shown on drawing ME-1 Legend, Site Plan, Schedules and Drawings List.

.2 The equipment schedules are to be read in conjunction with the pertinent sections of the specification. The specification sections and the schedules are complimentary to one another.

.3 The equipment make and size shown in the schedules is that which the project design and drawings are based on and for which space in the building design has been allocated.

.4 Bids shall be based on use of the equipment shown in schedules. During the solicitation period, alternative materials may be considered provided full technical data is received in writing by the Contracting Officer at least ten (10) calendar days prior to the solicitation closing date. If the alternative materials are approved for the purposes of the bid, an addendum to the bid documents shall be issued.

.5 It shall be the contractors and equipment suppliers responsibility to assure that the alternate equipment meets all the requirements of the specification, is of adequate size and capacity, has similar electrical characteristics, is suitable for the duty intended, and is of a physical size and shape to fit into the space which has been allocated in the system design.

.6 Where any alternate equipment fails to meet any of the criteria for the use of alternate equipment spelled out in this specification, it shall be rejected for use in the project.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Perform all Work required to provide and install ductwork insulation and jackets indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCE STANDARDS

.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

.2 All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project

.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.

.1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.2 ASTM C168 - Terminology Relating to Thermal Insulation Materials.

.3 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.4 ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.5 ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

.6 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.7 ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

.8 ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

.9 ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

.10 ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.11 ASTM E84 - Surface Burning Characteristics of Building Materials.

.12 ASTM E96 - Water Vapor Transmission of Materials.

.13 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

.14 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.15 NFPA 255 - Surface Burning Characteristics of Building Materials.

.16 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.17 UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

.18 UL 723 - Surface Burning Characteristics of Building Materials.

.19 ASTM E2336 - Standard for Grease Ducts.

.20 ASTM D5590 - - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.3 QUALITY ASSURANCE

.1 All ductwork requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

.2 All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

.3 Application Company Qualifications: Company performing the Work of this Section must have minimum three (3) years experience specializing in the trade.

.4 All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.

.5 All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy Work will not be acceptable.

1.4 SUBMITTALS

.1 Product Data

.1 Provide product description, list of materials, "k" value, "R" value, mean temperature range, and thickness for each service and location

.2 Record Documents

.1 Submit under provisions of Division 01

.3 Operation and Maintenance Data

.1 Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.

.2 Manufacturer's Installation Instructions: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, protect, and handle products to the Project Site under provisions of Division 01 and manufacturers recommendations.

.2 Deliver materials to Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

.4 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements,

Part 2 Products

2.1 GENERAL

.1 All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 INSULATION MATERIALS

.1 Type D1: Flexible glass fiber; ASTM C553 and ASTM C1290; commercial grade; 'k' value of 0.25 at 75 degrees F; 1.5 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.

.2 Type D2: Rigid glass fiber; ASTM C612, Class 1; 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.

.3 Type D3: Ductliner, semi-rigid, fibreglass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable acrylic surface coating specifically formulated to:

.1 Be no more corrosive than sterile cotton when tested in accordance with the test method for corrosiveness in ASTM C665.

.2 Absorb no more than 3 percent by weight when tested in accordance with the test method for moisture vapor absorption in ASTM C1104.

.3 Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM C1071, ASTM C1338, ASTM G21, and ASTM G22.

.4 Show no signs of warpage, cracking, delaminating, flaming, smoking, glowing, or any other visibly negative changes when tested in accordance with the test method for temperature resistance in ASTM C411.

.5 Have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.

.6 Meet the sound absorption requirements when tested in accordance with the test method for sound absorption in ASTM C423.

.7 Show no evidence of continued erosion, cracking, flaking, peeling, or delamination when tested in accordance with the test method for erosion resistance in UL181.

2.3 INSULATION ACCESSORIES

.1 Adhesives: Waterproof vapor barrier type, meeting requirements of ASTM C916;

.2 Weather Barrier: Breather Mastic.

.3 Vapor Barrier Coating: Permeance - ASTM E 96, Procedure B, 0.08 perm or less at 45-mil dry film thickness, tested at 100F and 50%RH.

.1 When higher humidity levels may be of concern, only specify the following fungus/mold resistant coating. Coating must meet ASTM D 5590 with 0 growth rating.

.4 Reinforcing Mesh: 10x10 or 9x8 glass mesh.

.5 Jacket: Pre-sized glass cloth, minimum 7.8 oz/sq yd.

.6 Type D4 Insulation Adhesive: Fire resistive to ASTM E84.

.7 Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

.8 Joint Tape: Glass fiber cloth, open mesh.

.9 Tie Wire and Wire Mesh: Annealed steel, 16 gage.

.10 Stainless Steel Banding: 3/4-inch wide, minimum 22 gage, 304 stainless.

Part 3 Execution

3.1 PREPARATION

.1 Verify that ductwork has been tested before applying insulation materials.

.2 Verify that surfaces are clean, foreign material removed, and dry.

.3 Maintain required ambient temperature during and after installation for a minimum period of 24 hours.

3.2 INSTALLATION

.1 Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

.2 Insulate ductwork as indicated on the drawings and in the Ductwork Application and thickness Schedule in this Section.

.3 All installation shall be in accordance with manufacturer's published recommendations.

.4 Extend duct insulation without interruption through walls, floors, and similar penetrations, except where otherwise indicated.

.5 Provide external insulation on all round ductwork connectors to ceiling diffusers and on top of diffusers as indicated in the Ductwork Insulation Application and Thickness Schedule and the Drawings. Secure insulation to the top of ceiling diffusers with adhesive that meets NFPA 90A and 90B 25/50 requirements, and vapor barrier or tape to match jacket. Do not insulate top of ceiling diffuser if it is used in ceiling return air plenum or in an open space with no ceiling.

.6 Flexible and Rigid fiberglass insulation (Types D1 and D2) application for exterior of duct:

.1 Secure insulation jacket joints with vapor barrier adhesive or tape to match jacket.

.2 Install without sag on underside of ductwork. Use 4-inch wide strips of adhesive on 8-inch centers and mechanical fasteners where necessary to prevent sagging.

Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

.3 Insulate standing seams and stiffeners that protrude through the insulation with 1-1/2 inch thick, unfaced, flexible blanket insulation. Cover with reinforcing mesh and coat with vapor barrier finish coating.

.4 On circumferential joints, the 2-inch flange on the facing shall be secured with 9/16 inch outward clinch steel staples on 2-inch centers, and taped with minimum 3-inch wide strip of glass fabric and finish coating.

.5 Vapor seal all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh.

.7 Duct Liner (Type D3) application for interior of ductwork where indicated and in return air sound boots:

.1 Duct dimensions shown on drawings are inside clear dimensions, with the coated side exposed to the air stream.

.2 Fasten duct line to the interior sheet metal surface with 100% coverage of duct liner adhesive, except where welded pins are to be applied. Where welded pins are to be applied, leave 50 mm x 50 mm (2" x 2") clean spaces.

.3 Install welded securing pins/holding washers not more than 450 mm (18") on centres and provide not less than two rows per surface.

.4 Protect/secure leading and trailing edges of duct insulation using sheet metal nosing folded over to hold the edge of the insulation and secured with insulation sealant.

.5 Seal raw edges, joints, damaged liner holding pins and washer heads with reinforcing membrane and a heavy coat of insulation sealer.

3.3 INSPECTION

.1 Visually inspect the completed insulation installation per manufacturers recommended materials, procedures and repair or replace any improperly sealed joints.

.2 Where there is evidence of vapor barrier failure or "wet" insulation after installation, the damaged insulation shall be removed, duct surface shall be cleaned and dried and new insulation shall be installed

3.4 DUCTWORK INSULATION APPLICATION AND THICKNESS SCHEDULE

Ductwork System	Application	Insulation Type	Insulation Thickness
Supply Air (Indoor) (Hot, Cold, Combination)	Outside of Mechanical Rooms	D1	50 mm
	Inside of Mechanical Rooms	D2	37 mm
Relief Air, and Exhaust Air (Indoors)	Only Where noted on Drawings	D3	25 mm

Ductwork System	Application	Insulation Type	Insulation Thickness
Outside Air	Treated and Untreated	D1	50 mm
Supply Air Ducts & Exhaust air upstream of HRV-1).	Outdoor Environment	D3	75 mm
Return Air Sound Boots/Elbows	All	D3	12 mm

Insulation thickness shall be as scheduled, unless noted otherwise on the accompanying drawings.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM C335-[05ae1], Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C449/C449M-[07], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C533-[07], Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.4 ASTM C547-[07], Standard Specification for Mineral Fiber Pipe Insulation.

.5 ASTM C553-[02], Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.6 ASTM C612-[04e1], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.7 ASTM C795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52MA-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB 51.53-[95], Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards [2005].

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-[07], Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Manufacturer's Instructions:

.1 Include procedures to be used and installation standards to be achieved.

.3 Qualifications:

.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of, or member of TIAC.

Part 2 Products

2.1 COMPONENTS

2.2 FIRE AND SMOKE RATING

.1 Fire and smoke ratings to CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

2.4 CEMENT

.1 Thermal insulating and finish

.1 To: ASTM C449/C449M.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.5 JACKETS

.1 Aluminum:

.1 Aluminum sheet metal formed to suit application.

.2 Lagging adhesive: compatible with insulation.

.3 SS strapping for fastening.

.2 Contact adhesive: quick setting.

.1 Maximum VOC limit 80 g/L [to SCAQMD Rule 1168 GSES GS-36.

.3 Tie wire: 1.5 mm diameter stainless steel.

.4 Bands: Stainless steel, 19mm wide, 0.5 mm thick.

.5 Fasteners: 2 mm diameter pins with 35 mm diameter or square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

.1 Maximum VOC limit 80 g/L [to SCAQMD Rule 1168 GSES GS-36.

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 testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards

.2 Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

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

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

.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 a member of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with WBC requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool and elastomeric insulation.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Maximum "k" factor: to CAN/ULC-S102.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S102.

.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702, ASTM C547.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S102

.6 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S102.

.4 Certified by manufacturer: free of potential stress, corrosion, cracking, corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: to CAN/ULC-S102.

.3 Design to permit periodic removal and re-installation.

2.3 HOT WATER HEATING PIPING & FITTINGS

.1 All hot water heating piping and fittings shall be insulated with 2.5 kg/m^3 (5-1/2 lb.) density molded preformed fiberglass pipe insulation with integral all-service jacket.

.2 All Chilled water piping and fittings shall be insulated with 2.5 kg/m^3 (5-1/2 lb.) density molded preformed fiberglass pipe insulation with integral vapour retarder jacket.

.3 All fittings insulation shall be prefabricated for its intended use and to be sized appropriately per manufacture installation requirements; insulation to fit snug to pipe fittings.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain or 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, 19mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.9 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 Moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint or by Consultant.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.75mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks (except on cold & chilled water) .

.3 Pressure sensitive vinyl tape of matching colour.

.2 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: smooth or stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory applied moisture barrier.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300mm spacing.

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 To be supplied & installed by mech. on all oversized requiring a continuous vapour barrier. Mech contractor to ensure product stays dry & damage free.

.2 Install in accordance with TIAC National Standards.

.3 Apply materials in accordance with manufacturers instructions and this specification.

.4 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.6 Pipe shield:

.1 Provide Aluminum Victaulic fitting with compatibility for 1", 1.5" & 2" thermal insulation.

.7 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, strainers, primary flow measuring elements, 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, SS, PVC or ABS.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Pipe insulation to include expansion joints, valves, strainers, primary flow measuring elements, flanges, unions and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS wire bands

.2 Tape at 300 mm on centre.

.3 Seals: lap seal adhesive, lagging adhesive.

.4 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS wire bands

.2 Tape at 300 mm on centre.

.3 Seals: VR lap seal adhesive, VR lagging adhesive.

.4 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6

.1 Insulation securements:

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code:

.5 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements:

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.6 TIAC Code: A-2

.1 Insulation securements:

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-H.

.7 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 degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 to <1 ½	1 ½ to < 4	4 to < 8	8 & over
Hot Water (Glycol) Heating	60 - 94	[A-1]	38	38	38	50	50	50
Domestic CWS with vapour retarder		[C-2]	25	25	25	38	38	38
Refrigerant hot gas, suction	All	[A-6]	25	25	25	25	25	25
Refrigerant liquid line	All	[A-6]	13	13	13	13	13	13

.8 Finishes:

.1 Exposed indoors: aluminum or PVC jacket.

.2 Exposed in mechanical rooms: aluminum or PVC jacket.

.3 Concealed, indoors: No further finish.

.4 On TIAC code A-3 insulation, use vapour retarder jacket compatible with insulation.

.5 Outdoors: water-proof aluminum jacket, silicone seal all joints.

.6 Finish attachments: SS bands, at 300 mm on centre. Seals: wing style.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

.2 Sustainable requirements for construction and verification:

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5- 03, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18- 01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22- 01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1- 96, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M- 99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M- 04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M- 99, Standard Specification for Seamless Copper Tube Metric .

.4 ASTM B837- 01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1- 03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB- 00, Natural Gas and Propane Installation Code Handbook.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturer’s catalogue literature following valves.

.3 Submit WHMIS MSDS construction and Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 All works related to the gas systems installations shall be conducted by professional gas fitter.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Brazing: to ASTM B837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug type.

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

.1 Install in accordance with Section 23 05 01 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.

.2 Provide gas piping for the new heating boilers as per boilers manufacturer's recommendation and up to the latest version of the BC Gas Code.

.3 Gas pipes are not shown on the drawings for clarity purposes.

.4 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

.5 Contractor to obtain all necessary approvals for the upgraded gas installation. Provide to Consultant for review.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1 CAN/CSA B149.2 and requirements of authorities having jurisdiction.

3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 CAN/CSA B149.2.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 05 - Installation of Pipe Work

.2 Section 23 05 17 - Pipe Welding

.3 Section 23 05 05 Installation of Pipework

.4 Section 23 05 23.01 - Valves - Bronze

.5 Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check

.6 Section 23 05 17 - Pipe Welding.

.7 Section 23 05 93 - Testing, Adjusting and Balancing

.8 Section 23 08 02 - Cleaning and Start-Up

1.2 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems services piping.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3-98, Malleable Iron Threaded Fittings.

.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).

.6 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

.1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-025, Butterfly Valves.

.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS6:

.2 NPS8 and over;

.2 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.3 NPS2-1/2 and over:

.1 Welding fittings and flanges: to CAN/CSA W48

.4 Flanges: plain or raised face, slip-on weld neck to AWWA C111.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

2.2 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3

2.3 VALVES

.1 Connections:

.1 NPS2 and smaller: screwed ends.

.2 NPS2.1/2 and larger: Flanged ends.

.2 Gate valves: to MSS-SP-70 to MSS-SP-80. Application: Isolating equipment, control valves, pipelines.

.1 NPS2 and under:

.1 Mechanical Rooms and elsewhere: Class 125, rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS2 1/2 and over:

.1 Mechanical Rooms and elsewhere: rising stem, solid wedge disc, bronze] trim, as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.3 Butterfly valves: to MSS-SP-67 Application: Isolating cells or section of multiple component equipment (eg. multi-section coils, multi-cell cooling towers):

.1 NPS21/2 and over: Lug type or Grooved ends: as specified Section 23 05 05 Installation of Pipework

.4 Globe valves: to MSS-SP-80 85 Application: Throttling, flow control, emergency bypass:

.1 NPS2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: Globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS21/2 and over:

.1 With bronze disc and trim, as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.5 Balancing, for TAB:

.1 Sizes: Calibrated balancing valves, as specified this section.

.2 NPS2 and under:

.1 Mechanical Rooms and elsewhere: bronze body, globe style, with bronze flow control plug and stem with handwheel and turn indicator:

.3 NPS2.5 and over

.1 Mechanical Rooms and elsewhere: ductile iron body with grooved ends, globe style, with bronze flow control plug and stem with handwheel and turn indicator:

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze

.7 Swing check valves: to MSS-SP-71.

.1 NPS2 and under:

.1 Class 125swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze

.2 NPS21/2 and over:

.1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.8 Silent check valves:

.1 NPS2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check

.9 Ball valves:

.1 NPS2 and under as specified Section 23 05 23.01 - Valves - Bronze

.10 Lubricated Plug Valves

.1 NPS2 and under:

.2 NPS21/2 and over:

.1 As specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work

3.2 CIRCUIT BALANCING VALVES

.1 Install flow balancing valves where indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 01 74 11 - Cleaning and 23 05 06 Mechanical Piping Cleaning.

3.4 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-04(2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2004), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 AUTOMATIC AIR VENT

.1 All high points in the piping system, heating coils, cooling coils, unit heaters, etc., shall be fitted with automatic air vents. Automatic air vents shall be for systems with working pressures up to and including 1034 Kpa. Install a 20 mm ball valve on the system side of each air vent and run a 6 mm copper drain line away from each vent to drain.

.2 Access panels shall be provided for all air vents located concealed in walls, ceilings, shafts, etc.

.3 Drain lines from automatic air vents shall be 6 mm hard drawn copper tubing run in a neat and workmanlike manner properly secured in place. A maximum of 2 air vent drains may be piped in a common drain line. Drains shall be run to the nearest suitable drain as directed on the site. All drain lines shall terminate in a visible location. Drain lines shall be located, run, and terminated such that they will not be subject to accidental damage or vandalism.

2.2 PIPELINE STRAINER

.1 Strainers size 50 mm and smaller screwed, size 65 mm and larger flanged, suitable for 860 kPa W.S.P.

.2 Strainer baskets shall be stainless steel or Monel with perforations properly sized for the service to be performed.

.3 Flanged strainers shall be fitted with a blow-off pipe fitted with a ball valve, nipple, and cap, full size of the strainer blow-off tapping. Screwed strainers shall be fitted with a blow-off tapping fitted with a plug.

2.3 PRESSURE RELIEF VALVES

.1 Pressure Relief Valves outlets shall be piped to the drain. Drain piping is not shown on the drawings for clarity.

.2 Pressure Relief Valves to be provided where indicated on the drawings, minimum size to be line size.

.3 Outlet line from PRV's shall be same size as the valve outlet, hard drawn copper tubing run in a neat and workmanlike manner properly secured in place. One pipe per PRV. Outlet pipes shall be run to the nearest suitable drain as directed on the site by the Consultant. All lines shall terminate in a visible location.

2.4 BALANCING RELIEF VALVES

.1 Balancing valves shall be like Tour and Anderson STAD series for DN 50 and smaller; STAF for DN 65 and up.

.2 All new balancing valves shall be equipped with factory supplied plugs for water flow measurements (Pete Plugs)

.3 For GPM flows refer to 23 06 00 Equipment Schedules.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Consultant'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.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.4 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for copper tubing and fittings for refrigerant between the indoor heat pumps and the outdoor heat pumps.

.2 Insulation of the refrigerant suction and liquid line piping.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22-[01], Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.26-[88], Cast Copper Alloy Fittings for Flared Copper Tubes.

.3 ASME B31.5-[01], Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B280-[03], Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52-[99], Mechanical Refrigeration Code.

Part 2 Products

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B280, type ACR.

.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature, 121° C.

.2 Brazed and/or flared:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%P and non-corrosive flux.

.3 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

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

2.4 VALVES, FILTER DRYERS, SIGHT GLASS

.1 Ball type valves, full port size, 4 Mpa pressure rating, with brass body, brazed connections, suitable with all refrigerants.

.2 Filter dryer, 3.5 MPa pressure rating, UL/cUL listed, high retention filter to 25 microns.

.3 Sight glass, 4 MPa pressure rating, solid brass hermetically sealed viewing window.

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 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 Provide a system piping schematic for the refrigeration systems and submit to and receive approval by the Original Equipment Manufacturer and the Departmental Representative prior to installation. Provide solenoid and thermostatic valves for each refrigerant circuit.

.2 Drill holes in exterior walls, roof as required to extend the piping up to the condensing unit on the roof. Insert sleeves in the openings, caulk and fasten in place. Caulk between refrigerant piping and sleeves.

.3 Where refrigerant pipes and conduits pass through roofing membrane, seal around piping in accordance with RCABC standards.

.4 Refrigerant piping shall be supplied and installed by an experienced, qualified and “licensed" Refrigeration Contractor.

.5 Refrigerant piping shall be refrigerant grade copper ASTM B88 type “L”. Install to CSA Standards, B-51 and B-52 Mechanical Refrigeration Codes. Confirmation to these requirements and those of regulating authorities requires that the applicable requirements for brazing procedures, quality control and other related requirements shall be followed.

.6 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.

.7 Provide as a minimum, all of the components shown on the refrigeration schematic. All piping and fittings shall be new and sized for the refrigerant supplied with refrigerant unit.

.8 All systems shall have provisions to handle safely the refrigerant charge for servicing purposes without venting the charge to atmosphere. This may include properly located stop valves, liquid transfer valves and refrigerant storage tanks for the safe transfer, discharge and disposal of the charge without venting the charge to the atmosphere.

.9 Provide stop valves at the locations shown on the piping schematic.

.10 Refrigerant lines crossing an open space shall be not less than 7.5 ft, (2.3 m) above the floor.

.11 Support piping on C Block supports (min 300 long) on the roof.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.4 PIPING INSULATION

.1 Insulate suction lines with 25 mm (1") thick, neoprene foam, (Armaflex), preformed pipe insulation and liquid lines with 12 mm (½") thick neoprene insulation. Seal joints with approved sealant.

.2 Except in concealed ceiling spaces, provide a single PVC or aluminum jacket around both pipes.

.3 Exposed piping on roof shall be insulated with 1" thick, (25mm) and covered with aluminium jacket with all joints sealed with silicone sealant.

3.5 FIELD QUALITY CONTROL

.1 Ambient temperatures to be at least 13degrees C for at least 12 hours before and during dehydration.

.2 Use copper lines of largest practical size to reduce evacuation time.

.3 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.4 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.5 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa absolute and hold for 4 h.

.2 Break vacuum with refrigerant to 14 kPa.

.3 Final to 5 Pa absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Pressure test shall be witnessed by the Departmental Representative and the system demonstrated to hold a vacuum of 100 microns for a period of 24 hours. Written acceptance of this refrigerant test shall be obtained prior to charging the system with refrigerant.

.6 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 Refrigerant shall be R-410a.

.3 With compressor 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.

.4 Re-purge charging line if refrigerant container is changed during charging process.

.7 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Start-up and Commissioning of the refrigeration system shall be executed in the presence of the factory representative, the Consultant and the Commissioning Agent.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, Section VII-2004.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
Include product characteristics, performance criteria, and limitations.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 A 20% propylene glycol and water mixture is to be used in the glycol heating system.

.2 The glycol shall contain a system inhibitor in the recommended quantities.

.3 After filling the system, leave the glycol fill tank full of a 20% glycol solution.

Part 3 Execution

3.1 CLEANING OF MECHANICAL SYSTEM

.1 Prior to the interconnection of the new boiler all hydronic systems, both new and existing, shall be chemically cleaned.

.2 Cleaning shall commence prior to the new glycol heating heat pump being installed.

.3 Cleaning shall be carried out to the recommendation of and under the direction of a professional chemical cleaning and treatment agency, and their agents, or approved alternate.

.4 On completion of the system cleaning, all systems shall be flushed out with clean water until all traces of the cleaning chemical have been removed. All strainer baskets shall be removed, cleaned, and replaced.

3.2 PIPING SYSTEM CHEMICAL TREATMENT

.1 After cleaning and flushing, the chemical cleaning agency shall fill the closed system with a 20% propylene glycol and water mixture. The glycol shall contain a system inhibitor in the recommended quantities.

.2 All water treatment chemicals used in the system shall be as recommended by the chemical treatment agency. A letter signed by a principal of the cleaning agency, certifying the cleaning of the system and the final chemical treatment shall be filed with the Departmental Representative for approval. This shall include a chemical analysis of the final system water condition.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 02 81 01 - Hazardous Materials

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.2 SUMMARY

.1 Section Includes:

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

.2 Sustainable requirements for construction and verification.

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A653/A653M-03, 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-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

.3 IAQ Guideline for Occupied Buildings Under Construction 1995 1st Edition.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials for the following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

1.5 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 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.

.3 Class C: transverse joints and connections made air tight with sealant. 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 degrees C to plus 93 degrees C.

2.3 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: Centreline radius: 1.5 times width of duct.

.2 Round: smooth radius or five pieces. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 With double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct45 degrees entry on branch.

.2 Tapered fitting for round ducts.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.5 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Fire Protection and Safety Consultant requirements.

.2 Fire stopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.

.3 Joints: to ASHRAE SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: black steel angle with galvanized steel rods to ASHRAE and SMACNA as per the following table:

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 clamp steel 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.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with ASHRAE, SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Outdoor air intake.

.2 All outdoor ductwork.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder or weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope header ducts down toward risers.

3.4 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Do not install additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.6 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

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 2 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 degrees C to plus 90 degrees 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 double thickness with trailing edge, to recommendations of SMACNA.

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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 600 x 1200 mm for person size entry.

.2 600 x 600 mm for servicing entry.

.3 300x 300 mm for viewing.

.4 As indicated for kitchen exhaust duct.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices and ducts requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.3 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Departmental Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Single thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm or as indicated.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon or bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm and as indicated.

.4 Bearings: pin in bronze bushings self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage: 5 % at 500 Pa.

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 where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by balancing agency.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections:

.1 25 30 02 EMCS Field Control Devices.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Performance data.

.2 Dimensional data

.3 Physical size and arrangement

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

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

1.4 QUALITY ASSURANCE

.1 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated on accompanying drawings.

.2 Structurally formed steel, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Operator: to Section 25 30 02 – Field control devices

.6 Performance:

.1 Leakage: in closed position less than 2% of rated air flow at 250 Pa differential pressure across damper.

.2 Pressure drop at full open position less than 200 Pa differential across damper at 3.85m/s.

.3 Frames: insulated with extruded polystyrene foam with RSI 0.88.

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 where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door on the underside of the ductwork upstream/adjacent to each damper.

.5 Ensure dampers are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fire dampers

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A-[2002], Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112-[M1990], Fire Test of Fire Damper Assemblies.

.2 ULC-S505-[1974], Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Fire dampers.

.2 Fusible links.

.3 Design details of break-away joints.

.4 fire damper sleeves and retaining angles

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.4 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials as per manufacturer recommendations.

1.5 FIRE DAMPERS

.1 Fire dampers: arrangement Type A, B, or C to match existing, and bear label of ULC to meet requirements of Fire Commissioner of Canada FCC). Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 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.

.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

.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.

.9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Dampers HVAC and in manufacturer's instructions for fire dampers shall be followed.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing where indicated on the accompanying drawings.

.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.

.5 Co-ordinate 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.

.8 Repair deficiencies listed in tables on the drawings. Access to conduct the repair work on some of the fire damper installations is difficult. The contractor shall review the installations during the site visit and allow for these situations in his tender.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

.1 ANSI/NFPA 96- 04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM E90 - 04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 150 mm deep one-piece extruded aluminum, minimum 3mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum bird screen on inside face of louvres in formed U-frame.

.8 Finish: factory applied enamel. Colour: to Departmental Representative approval.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Filters and filter gauges for various types of mechanical air handling equipment.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA 96-[04], Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.1-[1992], Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10-[M90], Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11-[M85], Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12-[M85], Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.13-[85], Filter Media, Automatic Roll.

.5 CAN/CGSB-115.14-[M91], High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.6 CAN/CGSB-115.15-[M91], High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.7 CAN/CGSB-115.16-[M82], Activated Carbon for Odor Removal from Ventilating Systems.

.8 CAN/CGSB-115.18-[M85], Filter, Air, Extended Area Panel Type, Medium Efficiency.

.9 CAN/CGSB-115.20-[95], Polarized Media Air Filter.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Underwriters' Laboratories of Canada ULC -S111-[95], Standard Method of Fire Tests for Air Filter Units.

.1 ULC-S649-[1993], Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

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

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

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

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.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 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply one (1) complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between -40°C and +50°C.

.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities as per manufactures sections.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

.1 Holding frames: permanent with channel section, construction of extruded aluminum, 1.6 mm thick, except where specified.

.2 Seals: to ensure leakproof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on side of Air Handling Unit or fancoil units.

2.3 COTTON PANEL FILTERS

.1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.

.2 Holding frame: galvanized steel or slide in channel for side access.

.3 Performance:

.1 Average atmospheric dust spot efficiency 30 % to ASHRAE 52.1.

.4 Fire Rated: to ULC -S111.

.5 Nominal thickness: mm.

2.4 FILTER GAUGES - DIAL TYPE

.1 Magnehelic pressure differential gauge, direct reading.

.2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

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 GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FILTER GAUGES

.1 Install type as indicated across each filter bank in approved and easily readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections:

- .1 Section 01 35 29.06 - Health and Safety Requirements.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)

- .1 ANSI/ARI 210/240-03, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 ARI 270-95, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.

.3 Canadian Standards Association (CSA International)

- .1 CSA B52-99, Mechanical Refrigeration Code.
- .2 CSA C22.1 HB-02, Canadian Electrical Code Handbook.

.4 National Fire Protection Association

- .1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for packaged rooftop HVAC units.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout and dimensions; indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.6 Fan performance curves.

.7 Details of natural gas fired heating equipment.

.8 Details of vibration isolation.

.9 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Submit maintenance and engineering data for incorporation into manuals as specified. Include data as follows:

.1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.4 DELIVERY

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal, paper, plastic, corrugated cardboard, metal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

1.5 WARRANTY

.1 For Work of this Section 23 74 00 Packaged Outdoor HVAC Equipment, warranty period for the unit is 12 months.

.2 Details on extended warranties on compressors and heat exchangers for gas fired equipment to be submitted with shop drawings

Part 2 Products

2.1 <u>GAS FIRED MAKE UP AIR HANDLING UNITS (DIRECT FIRED)</u>

.1 GENERAL

.1 Make-up Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.

.2 Make-up air units shall have a direct fired heating section and be CETL, ETLUS approved as a complete package including accessories and controls for both sea level and high-altitude areas.

.3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close approximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETLUS, UL, CSA prior to shipment.

.2 ELECTRICAL

.1 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data.

.2 All electrical circuits shall undergo a dielectric strength test and shall be factory tested and checked as to proper function.

.3 The following components shall be provided with a 22 gauge (.85mm) solid, or 24 gauge (.70mm) perforated (40% free area) galvanized metal liner over insulated areas:

	Solid Liner	Perf. Liner	
- Fan Section	X_		___
- Burner Section	X_		___
- Filter Section	X_		

.3 CABINET

.1 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, electrical control panels, burner compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.2 Units shall be provided with:
Hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.
Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.
Lift out access panels either bolted or secured with two or more camlock fasteners must be provided in locations where non-regular access would be beneficial.

.3 All units shall be internally insulated with 2"(51mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density insulation. 1 1/2 lb./cu.ft. (24 kg/cu.m.) insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. 3 lb./cu.ft. (48 kg/cu.m.) insulation is secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.4 Unit casing floors in walk in sections shall be fabricated with 14 ga. (2.0mm) black iron floor with rust resistant and non-skid coating. Provide reinforcing channels under floor to minimize deflection.

.5 The floor of the inlet and filter section is to act as drain pan complete with 2" (51mm) upturn standing seams around perimeter (or 2" (51mm) perimeter collar continuously welded to the unit base) and welded corners to ensure the floor is watertight. Alternately screwing down, tack welding and caulking of this collar is not acceptable. Provide 1 ½" (38mm) drain connections for complete drainability of the base pan.

.6 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit. Provide certified storm louvers on air intake; rain gutters or

diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps. Units mounted on roof curbs to incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked.

.7 Provide roof mounting rails and flashing of the existing roof-mounted curb .

.4 FAN SECTION

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Airfoil and/or BI fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings.

.3 Drives shall be adjustable on fans with motors 7 1/2 HP (5.6 kW) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.4 Unit casing shall be of minimum 16-gauge (1.6mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and painted with a two-part epoxy with a UV resistant top coat. All unprotected metal and welds shall be factory coated.

.5 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.

.6 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.7 Provide standard belt guards on all units with walk in sections over 60" (1524 mm) high.

.8 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Provide seismic restraint type isolators containing compressed spring. Use of separate bumper or snubber is not acceptable. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.9 Fan motors shall be Super-E high efficiency, TEFC (totally enclosed fan cooled) Super E high efficiency.

.10 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run.

.11 Fans shall be plenum type configuration direct drive where noted in schedules. Fan wheels shall be of the non –overloading centrifugal backward incline type, constructed of aluminum and containing matching inlet venture for optimum unit performance. Fan block(s) have thrust restraint isolators that shall be provided for each fan block to minimize movement of the assembly(s). Each fan housing shall be square in shape and readily attachable in column sections as required.

.5 CONTROLS

.1 Provide variable air volume fan control for units, via variable speed drive. Drive shall be factory installed, balanced and tested at full rated load and speed prior to shipment.

.2 Provide speed controller (115V, 3 amps) to accept current, voltage, or pressure transducer signal input and interface to energy management system as required. The controller shall be UL approved and housed in a NEMA 1 enclosure, pre-wired with MAN-OFF-AUTO selector, manual operator speed potentiometer on front cover, and optional speed meter. The controller shall also provide independent adjustable soft-start for pre-set ramp up of the drive. In event of power failure or momentary interrupt, the unit shall automatically restart with preset ramp-up when power is restored. Controls shall be UL listed

.3 Sine wave carrier input, PWM output. IGBT transistors. Adjustable acceleration and deceleration timing.

.4 Keypad to be removable, with alphanumeric display able to provide output status monitoring, output frequency, output voltage, output RPM, and output current. Include fault log display with capacity for the recent 30 faults with a time stamp. Diagnostic display menus to include reference speed command, heat sink temp, bus voltage, active I/O command status, time from power up, and current setting.

.5 Unit mounted manual VFD bypass switch locks out VFD, fan runs on maximum set volume. Bypass switch and all interlock contacts are factory mounted and pre-wired.

.6 Line and load reactors required for all 575 volt applications.

.7 Drive to be factory supplied.

.8 Minimum CFM turndown to 43% on gas fired heat exchangers and systems.

.6 HEAT EXCHANGER AND BURNER

.1 Operating natural gas pressure at unit(s) manifold shall be 7"w.c. (1750 Pa).

.2 Burner assembly shall be a line type capable of modulating turn down ratio of 25:1. The assembly shall be constructed in a draw through arrangement. Outside air is drawn across the burner section at a constant velocity within the allowable limits of the burner design.

.3 All burner combustion air openings shall be located in stainless steel burner plates to maintain design combustion air requirements at all inputs. Combustion air openings in burner castings are not acceptable due to potential blockage from corrosion. Gas orifices shall be a maximum of ½" (13 mm) apart and gas burner connection size shall be 1 ½"(38mm) minimum in order to ensure full turndown performance..

.4 Burner assembly and piping to include modulating flow ratio valve, fail-safe shut off valve(s), main and pilot pressure regulators, manual shut off valves and electric pilot valve. Flame surveillance shall be with a solid-state programmed flame relay complete with flame rod. The gas train shall be in a cabinet enclosure. Insulation on indoor units shall be 1" (25mm) thick 1-1/2 lb./cu.ft. (24 kg/cu.m) Insulation on inlet section. Outdoor units shall have insulation between the outer cabinet and inner heat reflective galvanized steel liner downstream of profile plate in addition to neoprene-faced insulation in inlet section.

.5 Unit shall start from exhaust system interlock (by others) wired to unit control terminal strip as indicated on field wiring diagram. Unit discharge air temperature shall be maintained constant by a discharge air sensor which shall modulate the main flow ratio gas valve.

.6 direct fired burners shall be equipped with a programmed logic controller to provide discharge air temperature control and burner management functions. Controllers for direct fired burners incorporating the M-TRAC module shall include the following standard features;

.7 A built-in discharge air setpoint adjustment to allow discharge air setpoint between 47°F and 160°F

.8 Self-checking of discharge air sensor to identify out of range or fault conditions

.9 Built in auto by-pass low limit with alarm contact

.10 Flame relay monitoring

.11 Air sensor self test

.12 Air flow monitoring

.13 Optical isolation on BMS input

.14 Five LED indicator lights for status indication of 20 different status functions including: burner status, flame status, fan status, low limit and operation status

.7 FILTER AND ACCESSORIES

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.3 Provide Dwyer 3000 Photohelic air filter gauge with single pole double throw switch for remote alarm capabilities. Provide complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 1" (0-250 Pa). Where the filter gauges are provided on outdoor units they shall be mounted inside of a weatherproof enclosure with viewing window.

.4 provide intake air damper to close when the unit is off. Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.

.5 Damper blades shall be 18 gauge (1.3mm) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 48"(1219 mm). Damper linkage brackets shall be constructed of galvanized metal.

.6 Dampers shall be parallel blade dampers.

.7 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.8 Gas fired units shall also include high limit and combustion airflow switch.

.9 Fire alarm circuits shall be powered from a relay in unit circuitry.

.10 Factory installed and wired non-fused disconnect switch in CEMA/NEMA 3 weatherproof configuration or disconnect with integral door closure mounted on face of control panel. Automatic controls shall be housed in a control panel mounted in or on the air handling unit.

.11 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit

.12 Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.

2.2 PACKAGED AIR TO WATER HEAT PUMP UNITS (HP-HW)

.1 GENERAL

.1 Provide outdoor packaged Air-to-Water liquid Heat Pump with capacity, size and electrical requirements as scheduled on drawings.

.2 Heat Pump shall be designed to operate using R410A Refrigerant.

.3 Heat Pump shall be designed for parallel Load water flow.

.4 Heat pump shall be designed for simultaneous variable capacity heating and cooling operation

.5 The liquid to be chilled/heated will be a water / glycol mixture 80/20% respectively.

.2 Heat Pump Compressors

.1 Scroll type compressor shall be used. Compressors can consist of multiple ton modules. Each refrigerant circuit shall consist of an individual compressor set, common dual circuit evaporator, dual circuit condenser, electronic expansion valves, reversing valves, liquid line solenoid valves, filter driers, Fin and Tube coil, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-circuit Heat Pump must be able to produce heating or cooling water even in the event of a failure of one or more refrigerant circuits.

.2 Heat Pump Modules shall be ETL listed in accordance with

.3 UL Standard 1995, CSA certified per Standard C22.2#236.

.4 Modules shall ship wired and charged with refrigerant.

.5 Modules shall be factory run tested prior to shipment on an AHRI certified or 3rd party verified test stand.

.6 Compressors, heat exchangers, condenser fans, piping and controls shall be mounted on a heavy gauge, powder coated steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module. Module shall be provided within a steel enclosure suitable for outdoor use.

.7 Compressor: Each module shall contain two hermetic scroll compressors in a tandem piping arrangement mounted to the module with rubber-in-shear isolators. Each system also includes high discharge pressure and low suction pressure safety cut-outs.

.8 Exposed steel surfaces shall be provided with a powder coat paint finish.

.9 Load Water Mains: Each module shall include supply and return mains for Load water. Cut grooved end connections are provided for interconnection to four, six or eight inch standard piping with grooved type couplings. Rolled grooved shall be unacceptable.

.3 Load Water Heat Exchanger:

.1 Each load water heat exchanger shall be a brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig working pressure. The load heat exchanger shall not be mounted above the compressor, to eliminate the effect of migration of refrigerant to the cold evaporator with consequent liquid slugging on start-up.

.2 Each module shall contain dual fans for each refrigerant circuit. These fans shall be multi-blade vane-axial type made of plastic composite material for quiet operation. Fans shall be direct drive at maximum RPM of 1,150. Fan motors shall all be pressure controlled and suitable for outdoor use.

.4 Fans

.1 Provide Optional low noise ECM Fans.

.2 Blades are aluminum construction owlet design 7-blade axial fan with integral EC motor (direct drives with external VFD driven motors are not acceptable). Efficiency exceeds criteria set out in the ErP 2015 directive. Individual fans are factory tested. Encapsulation required. Encapsulation is a process of filling a complete electronic assembly with a solid compound for resistance to shock and vibration, and for exclusion of moisture and corrosive agents. Sound pressure reductions at 30 feet, as compared to standard fan option, ranges from 3-6 dBA.

.5 Central Control System.

.1 Scheduling of the various compressors shall be performed by a microprocessor-based control system (Master Controller).

.2 A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.

.3 The Master Controller shall monitor and report the following on each refrigeration system:

.1 Discharge Pressure Fault

.2 Suction Pressure Fault

.3 Compressor Winding Temperature

.4 Suction Temperature

.5 Load Water Leaving Temp.

.6 Load Water Entering and Leaving Temperature

.7 Discharge/Suction Refrigerant Temperature

.8 Load Water Flow

.4 An out of tolerance indication from these controls or sensors shall cause a “fault” indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire Heat Pump will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller’s LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).

.5 Individual monitoring of leaving Load water temperatures from each refrigeration system shall be programmed to protect against freeze-up.

.6 The Chiller shall be capable of interfacing to a building automation system. Interface shall be accomplished using an Interoperability Web Portal and shall be capable of communication over BACNet, Modbus or LON.

.7 Heat Pump shall have external inputs and outputs to be compatible with the building management system to include Remote Start/Stop capability and Alarm output

.8 Each refrigerant circuit shall include all refrigerant specialties including a properly sized refrigerant receiver to provide reliable operation down to 0°F Ambient.

.9 Heat Pump shall incorporate appropriate refrigerant specialties including a properly sized refrigerant receiver and flooded head pressure control valves for operation to -20°F.

.10 Heat Pump shall be provided with a single point power connection This will include pre-engineered wiring for field installation and connection to a factory mounted Heat Pump junction box. Junction box shall include individual fusing for each Module Set and provide a single point of connection to building power.

.11 Provide a Pump Module of size and capacity indicated on the drawings and schedules. The Pump Module shall be interconnected though the common Heat Pump header system and require no additional water connections. Pump Module will become an integral part of the Heat Pump system. Pump Module shall incorporate dual in-line centrifugal pumps in a Primary/Standby pumping arrangement. Pump starters and controls shall be provided to enable manual selection of lead pump. In addition, in the event of a loss-of-flow failure of the Load water system, the Pump Module controls shall disable the lead pump and automatically start the standby pump. Module shall be completely factory assembled and tested prior to shipment.

.12 Provide built in expansion tank which shall be welded steel with butyl rubber diaphragm and capable of a maximum operating temperature of 240 F and maximum working pressure of 100 psig. Tank shall be interconnected through the common Heat Pump header system and require no additional water connections. Module shall be completely factory assembled and tested prior to shipment.

.13 Miniglycol feeder shall be factory installed and piped.

.14 Provide Optional Glycol Feeder and Expansion Tank shall be incorporated into the Heat Pump system through a modular arrangement and interconnect through the common Heat Pump header system requiring no additional water connections. System shall include a 48 gallon storage/mixing tank with lid and cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out, and integral pressure switch; pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging and agitating contents of storage tank, adjustable 5-55 psi pressure regulating valve with pressure gauge, fast fill lever, integral replaceable strainer, built in check valve, and built in shut-off valve. Glycol feeder system shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage.

.15 Expansion tank shall be welded steel with butyl rubber diaphragm and capable of a maximum operating temperature of 240 F and maximum working pressure of 100 psig. Tank shall be interconnected through the common Heat Pump header system and require no additional water connections. Module shall be completely factory assembled and tested prior to shipment.

.16 IFM flow switches. Proof of flow and flow safety – ships loose for field installation.

.6 Lifting Frame

.1 Optional six (W6X15) inch I-beam painted steel frame will be provided with all modules mounted upon it. Typically, all water and wiring connections will be made between the modules at the factory. Depending on chiller length or customer requests, larger I-beams can be furnished.

.7 Safeties, controls and operation

.1 The Heat Pump safety controls shall be provided (minimum) as follows:

.2 Low refrigerant pressure

.3 Loss of water flow through the load water heat exchanger

.4 High refrigerant pressure

.5 High compressor motor temperature

.6 Low suction gas temperature

.7 Low leaving water temperature

Failure of Heat Pump to start or Heat Pump shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

.8 Normal Heat Pump Operation

.1 When Heat Pump is enabled, the factory supplied Master Controller stages the Heat Pump capacity from minimum to maximum as required by building load.

.2 The Heat Pump control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.

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 as per manufacturers' instructions on existing roof curb as indicated on drawings.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Provide manufacturer's field services, consisting of product use recommendations and site visits for inspection of product installation, if required, in accordance with manufacturer's instructions.

.2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.

.5 Performance Verification:

.1 Rooftop Make Up Air Handling Units:

.1 Set fan for full air flow to verify full heating.

.2 Confirm outdoor air damper operation.

.3 Set balancing air dampers for maximum air flow.

.4 Check for smooth, vibration less correct rotation of supply fan impeller.

.5 Measure supply fan capacity.

.6 Adjust impeller speed as necessary and repeat measurement of fan capacity.

.7 Measure pressure drop each component of air handling unit.

.8 Reduce fan speed to test operation at reduced air flow rates.

.9 OAD: verify for proper stroking, interlock with RAD.

.10 Measure DBT, WBT of SA, RA, EA.

.11 Simulate maximum heating load and:

.1 Verify temperature rise across heat exchanger.

.2 Verify combustion air flow to heat exchanger.

.3 Simulate minimum heating load and repeat measurements.

.12 Verify operating control strategies, including:

.1 Heat exchanger operating and high limit.

.2 Multi-speed operation.

.3 Freeze protection.

.4 Alarms.

.5 Voltage drop across thermostat wiring.

.6 Operation of remote Paint Room Control Panel including pilot lights, failure modes and graphics.

.7 Automatic Shut down on building fire alarm.

.2 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.6 Commissioning Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements

3.4 AIR TO WATER HEAT PUMP

.1 Supply water for the Load water circuit shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the Heat Pump's heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular Heat Pumps using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1. pH	Greater than 7 and less than 9
2. Total Dissolved Solids (TDS)	Less than 1000 ppm
3. Hardness as CaCO3	30 to 500 ppm
4. Alkalinity as Ca CO3	30 to 500 ppm
5. Chlorides	Less than 200 ppm
6. Sulfates	Less than 200 ppm

Manufacturer's Warranty: Manufacturer shall provide full parts-only warranty coverage for entire chiller for a period of one year. All parts shall be warranted against defects in material and workmanship. Similar parts-only coverage shall be provided for the chillers compressors for a period of five years. The warranty period shall commence either on the equipment start-up date or six months after shipment, whichever is earlier.

Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. Factory Authorized Service Engineer shall also be responsible for assembly of the chillers cabinetry package and electrical bus bar system. After start-up a Manufacturer's Representative shall provide a minimum of 8-hours of operator training to the owner's designated representative(s).

Commissioning agent to certify installation.
Start-up shall be performed by manufacturer's service company and a report generated on the Sales Agencies letter head. Service company performing the work must be the same as the company that supplies the product. Heat pump sales agency shall provide a 12 month labour warranty that shall commence on the start-up date of the unit. Substitution of this work to a subcontractor shall not be permitted.

Heat Pump manufacturer's service company shall provide 6 hours of on-site start-up, commissioning and running evaluation with an initial visit 4 weeks after starting up. (A total of 48 hours of technician time. Note that time spent on the start –up of the units is not part of this 48 hours).

Start up and commissioning shall be performed by the manufacturer. Use of a local refrigeration contractor will not be permitted
Commissioning agent to be present during start-up and certify performance.
Commissioning agent to Submit written report to Departmental Representative.

3.5 DEMONSTRATION

.1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 23 23 00 - Copper Tubing and Fittings Refrigerant.

1.2 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)

.1 ARI 210/240-1994, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 15-2001, Safety Standard for Refrigeration Systems.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-C273.3-M9 (R2001), Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.

.4 Environment Canada, (EC)/Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Sections 01 33 00 - Submittal Procedures.

.2 Indicate:

.1 Capacities.

.2 ARI Ratings.

.3 Electrical requirements

.4 Sound Power levels.

.5 Installation instructions.

.6 Start-up Instructions.

.7 O&M, Instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities in accordance with Section 01 74 21 Construction Demo Waste Management.

1.5 WARRANTY

.1 For heat pump compresors, the 12 months warranty period prescribed is extended to 5 years.

.2 Contractor hereby warrants heat pumps in accordance with GC 24, but for 5 years.

Part 2 Products

2.1 GENERAL

.1 Heat pumps: carry ARI or CSA certification seal.

2.2 REFRIGERANTS

.1 Type of Refrigerant: R-410A

2.3 SPLIT SYSTEM HEAT PUMPS

.1 GENERAL

.1 Multi-zone, heat pump unit consisting of multiple indoor units with fan and heating/cooling coil, drain pan and filter, paired with a single outdoor unit with compressor, condenser coil and reversing valve linked together with liquid and hot gas refrigerant piping system.

.2 Each multi-zone, split system heat pump shall meet the arrangement and performance specifications as indicated in the Mechanical Equipment Schedules.

.3 All required safety devices and controls shall be factory wired and tested.

.4 Each outdoor unit serves 1 to 2 indoor units. Indoor units shall be capable of simultaneous heating and cooling from different units. Multi-speed fans shall reduce air flow when loads are reduced to minimize noise and energy use.

.5 Power and control connections for the indoor units shall be connected to the outdoor unit serving it. Where required for multi-zone applications, refrigerant branch boxes shall be provided between the outdoor and indoor units.

.6 Large font, backlit, 7 day programmable thermostats shall be provided for each indoor unit. Thermostats shall be wall mounted and hard wired.

.2 INDOOR HEAT PUMPS

.1 Indoor heat pumps shall be heating and cooling, ducted fan coil units with refrigerant coil, drain pan, replaceable air filter and inlet/outlet duct connections.

.2 Power and control connections for the indoor units shall be connected to the outdoor unit serving it. For equipment which requires power feed from a separate source, the Contractor shall provide the separate power feeds as required.

.3 Each indoor unit shall operate in cooling or heating mode independent of which mode the other heat pumps are operating in.

.4 Fans shall be dynamically balanced with four air flow settings. Medium air flow shall be used unless indicated otherwise on the accompanying drawings.

.5 Cabinets shall be constructed from galvanised sheet metal with back return air arrangement unless indicated otherwise on the accompanying drawings.

.6 Filters to be 25 mm, MERV 8, replaceable, pleated filters.

.7 Indoor units shall be provided with a local disconnect safety switch.

.8 Indoor units shall be complete with a condensate drain pump. If a separate power supply is required for the condensate pump the contractor shall provide it as required.

.3 OUTDOOR HEAT PUMPS

.1 Outdoor heat pumps shall be heating and cooling, air source heat pumps with refrigerant compressor(s), condensing coil, drain pan and single point power connections.

.2 Outdoor heat pumps shall be complete with variable speed compressor, condenser coil and fan with auto change over between heating and cooling.

.3 Outdoor units shall have power and control connections with the indoor units it serves.

.4 Cabinet to be constructed of epoxy or powder coated, steel sheet metal with air inlet/outlet fan

.5 Units shall be suitable for heating at outdoor temperatures of -20 degrees C.

.6 Refrigerant shall be R410A.

.7 Compressor shall come with an extended 6 year warranty.

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated on drawings and in accordance with manufacturer's instructions.

.2 Install outdoor unit on sleepers/roof curbs seismically secured to the roof and flashed in to the roofing in accordance with established practice of the RCABC. Installation of the roofing work shall be done by a roofing contractor in good standing with the RCABC.

.3 Install indoor fan coil in ceiling spaces and provide ductwork as indicated on the accompanying drawings.

.4 The unit has an integral pump to deliver the condensate from the fan coil unit across the ceiling space to a sanitary drain or as indicated on the drawings.

.5 Route the refrigerant lines through the exterior and interior walls and up through the roof as indicated on the drawings. Core/cut through wall and roof as required.

.6 Wire the outdoor heat pump unit and fan coil as indicated on drawings.

.7 START-UP AND COMMISSIONING

.8 Manufacturer to certify installation.

.9 Manufacturer's trained technician to start/ supervise start of units and fill out a start up refrigerant report. Submit one copy to Departmental Representative and three copies to Contractor to insert in Manuals.

.10 Commission unit, check unit operation with remote controller. Adjust cooling set point to 23.5° C, heating set point to 21.° C.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

.4 Section 01 79 00 - Demonstration and Training.

.5 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

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

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

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

.2 Final Report: submit report to Departmental Representative.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by Departmental Representative before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

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

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Consultant and Commissioning Manager.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

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

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Commissioning Manager Engineer.

.3 Commission integrated systems using procedures prescribed by Commissioning Manager Engineer.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.

.3 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.4 Additional instruments to include:

.1 DP transmitters.

.2 VAV supply duct SP transmitters.

.3 DP switches used for dirty filter indication and fan status.

.5 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC .

.6 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.7 Departmental Representative to mark instruments tracking within 0.5 % in both directions as "approved for installation".

.8 Transmitters above 0.5 % error will be rejected.

.9 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and

Departmental Representative. This document will be used in final start-up testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final start-up testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Prior to beginning of 30-day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30 consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.5 Commissioning Manager Engineer to verify reported results.

3.3 DEMONSTRATION

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work

.2 Section 01 33 00 - Submittal Procedures

.3 Section 01 78 00 - Closeout Submittals

1.2 GENERAL

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown in the Project Specification.

.2 The Work shall include but not be limited to the supply of all labour, materials, equipment and supervision to complete the Work as required by the Contract Documents.

.3 Existing security, smoke control, fire alarms and monitoring shall be uninterrupted by the installation.

.4 Carefully examine the existing building, local conditions affecting the Work and building site, together with all other trades to make sure that Work under this Specification can be satisfactorily carried out without changes. Work of all trade Divisions shall be examined, before commencing Work, and any defect or interference affecting Work shall be reported at once.

.5 The Contractor, when estimating, shall visit the site and make himself familiar with all existing conditions and allow for same in his tender.

1.3 INTENT

.1 Work shall be in accordance with the specifications and their intent, complete with all necessary components, including those not normally shown or called for, and shall be ready for operation before acceptance.

.2 Any reference to the “engineer” or "consultant" shall mean the departmental representative.

.3 The work "provide" shall mean "supply and install" unless otherwise indicated.

.4 The new installation shall meet the existing building standards in all aspects.

1.4 INTEROPERABILITY REQUIREMENTS

.1 All DDC equipment shall be BACnet compatible and operate seamlessly with the existing DDC systems hardware, software and firmware.

1.5 CONTROLS CONTRACTOR REQUIREMENTS

.1 The Control System to be installed shall be Delta Controls, or approved equivalent.

.2 The EMCS Contractor shall have an established working relationship with the Control System Manufacturer of not less than three years.

.3 The EMCS Contractor shall be staffed by trained personal capable of maintaining the system and training client staff. The local office shall have local availability of replacement parts

.4 The EMCS Contractor shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.

.5 EMCS Contractor shall demonstrate capacity to respond emergency calls by a local contractor (or his representative) within a two hours period of the call.

.6 The EMCS Contractor shall provide 24-hour response in the event of a customer call.

1.6 CODES, STANDARDS AND PERMITS

.1 Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section. All equipment shall be installed in accordance with the latest requirements of the following:

.1 The local Building Code

.2 The B.C. Building Code

.3 The Workers' Compensation Act

.4 The Canadian Electrical Code

.5 The Canadian Standards Association

.6 National Fire Protection Association

.2 Electric equipment shall bear CSA labels and, where applicable, ULC label certifying compliance with test standards of these agencies.

.3 Obtain all required permits and pay all fees therefore and comply with all provincial, municipal, and other legal regulations, codes and by-laws applicable to the work.

.4 General contractor and all sub-contractors shall obtain security clearance as per Canadian Coast Guard requirements before performing any work inside the building.

1.7 LIABILITY

.1 Assume responsibility for laying out work and for damage caused by improper execution of work.

.2 Protect finished and unfinished work from damage.

.3 Take responsibility for condition of materials and equipment supplied and protect until work is completed and accepted.

.4 The owner shall have recourse in tort for any negligent action by the contractor or his representatives.

1.8 SIGNS AND PUBLICITY

.1 Neither the Contractor nor anyone directly or indirectly employed by them, shall post any site signs, nor release any publicity reports, photographs, sketches, plans or other information, orally or in writing, concerning the work performed or to be performed, without the prior written acceptance of the Owner's Representative.

1.9 PROJECT MANAGER

.1 The Contractor shall identify a Project Manager who will be responsible for all aspects of the project (including co-ordination of subcontractors and suppliers, permits, installation, commissioning, and contract administration).

.2 The Owner's Representative reserves the right to interview the prospective project manager to evaluate their understanding and ability to complete the project.

1.10 EXAMINATION OF SITE

.1 No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site.

.2 If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the contractor of responsibility to supply the intended equipment.

.3 Check drawings of all trades and survey the site to verify space availability for the installation. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent without written approval.

.4 Wall locations, ceiling layout, heights, and equipment locations shall be verified on site. Failure to do this shall not relieve the contractor of the responsibility for correct location of mechanical systems and equipment.

1.11 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by design authorities and the trade.

.2 Employ only tradesmen holding valid provincial trade qualification certificates. Tradesmen shall perform only work that their certificate permits.

1.12 NEW PRODUCTS ONLY

.1 All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. This installation shall not be used as a test site for any new products unless explicitly approved by the Departmental Representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.13 SHOP DRAWINGS

.1 Shop Drawings shall be submitted as per Section 01 33 00 – Submittal Procedures

1.14 AS-BUILT DRAWINGS

.1 As-Built drawings shall be submitted as per Section 01 78 00 – Closeout Submittal

1.15 OPERATING AND MAINTENANCE MANUALS

.1 Operating and Maintenance Manuals shall be submitted as per Section 01 78 00 – Closeout Submittal.

1.16 COMMISSIONING

.1 The control system must be commissioned and tested at the end of the work as per Section 01 91 13 – Testing and Commissioning.

.2 Results of all tests shall be documented by the Contractor and a hard copy of the commissioning sheets and trends covering a continuous period shall be submitted to the Consultant for review.

1.17 DEMONSTRATION

.1 A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed as per Section 25 01 12 ECMS Demonstration and Training.

.2 The contractor shall dedicate a minimum of one - 4 hour on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements.

.3 Demonstration shall be scheduled and witnessed by Contract Document O&M's Commissioning Manager.

.4 The demonstration constitutes a joint acceptance inspection, and acceptance of the delivered system for on-line operation.

1.18 TRAINING

.1 Training for the building operators and manager shall be performed as per Section 25 01 12 ECMS Demonstration and Training.

.2 A training of the control system capabilities shall be performed. The contractor shall dedicate a minimum of 4 x 4 hours on-site sessions with the Owner and his representatives for operator training.

.3 Training shall include but not limited to the explanation of system operation and capabilities, system navigation, setpoint adjustments, alarm acknowledge, weekly schedules, password settings, graphic screens creation and changes, trend log settings and visualization, database management, etc.

1.19 WARRANTY

.1 At the end of the final start-up/testing and commissioning, if equipment and systems are operating satisfactorily to the Owner and Owner's Representative, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance (substantial completion) shall be the start of warranty.

.2 Labour & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner.

.3 The warranty shall provide all material, parts and labour, including labour provided on an emergency response basis outside of normal working hours. Labour shall include any related travel time and other related costs associated with providing the warranty service.

.4 A detailed service report must be filed with the Owner after each warranty visit, detailing the work performed, time spent, devices replaced or repaired, and the personnel involved.

.5 Emergency calls during the warranty period shall be addressed by the Contractor within four (4) hours of notification. Service shall be available 24 hours per day, seven days a week. The Owner shall be provided an emergency phone number for contacting service personnel. The service call shall only be chargeable if inspection reveals any defect not directly covered under the terms of the specification.

.6 Warranty shall be submitted as per Section 01 78 00 – Closeout Submittal

1.20 OWNERSHIP OF PROPRIETARY MATERIAL

.1 All project developed hardware and software shall become the property of the Departmental Representative. These include but are not limited to:

.1 Project graphic images
.2 Record drawings
.3 Project database
.4 Job-specific application programming code
.5 All documentation

1.21 ACCEPTANCE

.1 The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Department and Departmental Representative.

.2 Any tests that cannot be performed due to circumstances beyond the control of the Controls Contractor may be exempt from the Completion requirements if stated as such in writing by the Departmental Representative. A deficiency amount will be held at Substantial Completion for such tests. Deficiency amounts will be released after tests are performed and documented to the satisfaction of the Departmental Representative.

.3 Warranty shall start from the date of all deficiencies are corrected and tests are performed and documented to the satisfaction of the Departmental Representative.

1.22 SUBSTANTIAL PERFORMANCE

.1 Once the above basic requirements are met and all other features of the system are complete and acceptable, Substantial Performance shall be granted. A deficiency list shall be prepared, and holdbacks applied. All deficiencies shall be corrected prior to Total Performance. Warranty shall start from the date of Substantial Performance of the work.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 78 00 - Closeout Submittals

.3 Section 25 05 01 – EMCS General Requirements

1.2 GENERAL

.1 The objective of the work is to upgrade the existing Delta Controls DDC System installed in the Buoy Maintenance Building on the Canadian Coast Guard Base in Victoria, BC.

.2 The Base has an existing Delta controls system on the base but not a full Delta controls system in the Buoy Maintenance Building. Upgrade Delta, DDC controls are to be provided to control the new make-up aid handling unit, AHU-3, the paint room make-up and exhaust system, the air source heat pump system including unit heaters and new room sensors.

.3 Variable speed drives are being installed on the two existing paint room exhaust fans. Variable speed drives shall be provided with BACnet protocol and connected to the DDC system.

.4 New over-ride control of existing electric baseboard heaters is to be provided as indicated on the accompanying drawings.

.5 New split system heat pumps are not connected to the DDC systems unless noted otherwise.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown in the Project Specification.

.2 Provide and install all hardware components necessary for a complete system installation, including network and communications devices; DDC controllers; field devices of all types, transformers, conduits, raceways, and wiring including power and network cabling;

.3 New DDC BACnet controllers shall be provided and installed as per this specification.

.4 New controllers shall be fully compatible with other on-site controllers, including full access to view and edit program code, with the new DDC system.

.5 Supply air temperature sensors for all the air handling units as indicated on the drawings.

.6 A BACnet Ethernet network shall be provided for communication between Building Controllers (B-BC) and Operator Workstation. BACnet MSTP network shall be provided between Building Controllers (B-BC) and Advanced Application Controllers (B-AAC).

.7 Variable speed drives are going to be provided with BACnet interface. DDC contractor shall connect the interfaces to the DDC network and map all the applicable points. Graphic screens with VSD information shall be created and linked to the applicable mechanical room graphic screen.

.8 New graphic screens shall be created for displaying relevant information for equipment with BACnet cards. Links shall be provided in each applicable system schematic screen to direction to these screens.

.9 Graphic screens shall be submitted and reviewed by the Consultant, and the Maintenance Team Leader. A copy of the as-built graphic screens and databases shall be saved on the PC workstation/server computer.

.10 Provide trend logs as required to reflect the system operation as per this specification to allow the building operator analysis and troubleshooting.

.11 Individual trend logs shall be created with all variables associated with each control loop on intervals and samples as required for loop tuning. These trends shall be disabled upon completion of loop tuning.

.12 All critical alarms, as defined by the Maintenance Team Leader, shall be generated and forwarded to the operator's e-mail, and text messages to the operator's cellular phone. Alternatives shall be discussed with Maintenance Team Leader before implementation.

.13 Remote access to DDC System shall be via Internet using existing communication. DDC contractor shall coordinate the remote connection with the Internet service provider.

.14 Provide all required labour and supervision for the installation, calibration, adjustments, checkouts, commissioning of all components and devices provided.

.15 The DDC system including new supervisory controllers and communication with existing controllers shall be fully tested and commissioned to prove point functionality and communication after installation.

.16 The DDC contractor shall provide a proposed schedule for replacing the DDC controllers with new controllers without compromising the operation of existing equipment. The HVAC systems shall remain operational at all times during occupancy. Fans shall run and reasonable temperatures shall be maintained in the occupied spaces.

.17 All re-used control devices such as temperature sensors, pressure transmitters, damper and valve actuators, shall be verified, tested, and calibrated as required. A list of defective devices shall be prepared and presented to the Departmental Representative.

.18 Removal of all unused DDC pneumatic controls and devices including tubing, actuators, controllers, and wiring including network.

.19 Patching and touch up paint to match existing or a provide cover plate where pneumatic sensors were removed or replaced with new DDC sensors.

.20 The new points and changes in the DDC system including new BACnet interface shall be fully tested and commissioned to prove point functionality and communication after installation.

.21 Update existing documentation including as built drawings, O&M manuals, commissioning reports, etc. with complete information of the installed system;

.22 Provide a complete demonstration of the control system capabilities as per this specification.

.23 Commissioning of the control system to prove point functionality and communication.

.24 Providing all required devices and coordinating with IT personnel for remote access to the DDC system via Internet.

.25 Providing complete documentation of the installed system with commissioning reports and Operations and Maintenance manuals.

.26 A copy of the as-built graphic screens and databases shall be saved on the onsite server computer supplied by the Client IT department.

.27 Commission the control system to prove point functionality and communication, as per Section 25 01 11.

.28 Training on the system operation for the building operation and maintenance personnel.

.29 Provide one-year Warranty as per this specification.

1.4 BRIEF DESCRIPTION OF BUILDING SYSTEMS

.1 Heating Systems

.1 Currently the building is heated by electric baseboard heaters with independent thermostats.

.2 Air Handling Systems

.1 Local exhaust systems provide ventilation in conjunction with make up air handling systems.

.3 DDC Controls

.1 The DDC system used on Base is a Delta Controls system.

1.5 WORK BY OTHERS

.1 Co-operate and co-ordinate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.

.2 If any part of work under this Contract depends on proper execution by or relies upon work of another Contractor, report immediately to the Departmental Representative, in writing, any situations which may interfere with proper execution of Work.

1.6 WORK IN EXISTING BUILDINGS

.1 All work on site shall be co-ordinated with the Departmental Representative so as to minimize disruptions. Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

.2 Work taking place outside of the occupied areas that does not involve power or comfort systems interruptions may occur during the day with prior approval from the Departmental Representative. Work in mechanical rooms can be performed during occupied periods between 8:00AM and 4:00PM and anytime if required to complete the work. Coordinate with the Maintenance Team Leader, in advance the areas and intended working hours.

.3 Installation of equipment in occupied areas must take place outside of regular business hours. Desks, equipment, and furniture must be covered when the work is taking place. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Departmental Representative.

.4 Include in Price any overtime that may be required to tie-in services at night or on weekends.

.5 Use only designated elevators, existing in building for moving workers and material.

.6 Obtain approval from the Departmental Representative prior to penetrating any structural surfaces including floor slabs. Obtain from the Departmental Representative approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.7 Carefully route new conduits and other new services so that they do not interfere with existing installation. Arrange and pay for any necessary relocation of existing conduit, cable tray, bus duct or any other services required for the proper installation of new Work.

.8 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Departmental Representative.

.9 After completion of work in ceiling space, arrange and pay for the repair of any damaged or dislodged fireproofing or other building materials.

.10 In area with solid ceilings, electrical and systems junction boxes along with associated wire and conduit shall be relocated to areas where ceiling access is possible, or access panels may be provided with the approval of the Departmental Representative.

.11 All Contractors shall exercise due care and diligence in working in the occupied areas. Keep the job reasonably clear of waste material and rubbish at all times during progress of the work. Clean up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.12 Protect all existing services and make good any damage occasioned by the work in this contract.

.13 The Owner reserves the right to complete and/or repair any work that is not in operating condition, beyond scheduled shutdowns, in order to maintain the Owner's operation.

1.7 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods.

.2 Obtain permission of the Owner before shutting down or disconnecting electrical and fire protection services. Shutdowns of systems are to be co-ordinated with the Facilities Manager or designated DFO representative.

.3 Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time.

.4 Notify, Departmental Representative of intended interruption of services and obtain required permission.

.5 Allow for after hours work for services to be done inside occupied areas during office hours.

.6 Protect all existing services and make good any damage occasioned by the work in this contract.

.7 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.

.8 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.9 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.

.10 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

1.8 CLEANING

.1 The Contractor shall be responsible to keep the building, site, and premises clean and tidy with respect to his work at all times.

.2 On completion, all dirt and rubbish for which the Contractor is responsible shall be removed from the site and premises and the whole left clean and tidy. All soiling of finished walls, floors, ceilings, carpets, or other surfaces caused by the Contractor shall be cleaned up or made good by the Contractor.

.3 All control panels, etc., shall be thoroughly cleaned of dust, dirt, and debris before start-up and hand-over.

1.9 DOCUMENTS REQUIRED

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

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Reviewed Shop Drawings.

.5 Change Orders.

.6 Other Modifications to Contract.

.7 Field Test Reports.

.8 Copy of Approved Work Schedule.

.9 Health and Safety Plan and Other Safety Related documents.

.10 Other documents as specified.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS), work and nameplates materials, colours and lettering sizes.

1.2 RELATED SECTIONS.

.1 Section 01 11 00 – Summary of Work

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 – Closeout Submittal

.4 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

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

1.4 DEFINITIONS

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

1.5 LANGUAGE

.1 Identification shall be in English.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by laminated plastic, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Inscriptions: machine engraved to identify function.

.4 Identifiers shall match record documents.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 2" of termination with a cable identifier. Cable identifier shall be shown on and match record documents.

.3 Colour coding: Use colour coded wiring in communications cables, matched throughout system.

.4 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

.1 Junction and Pull boxes shall be adequate tagged to indicate its use for DDC system. Self sticker labels with controls company logo could be used for that purpose.

.2 Identify each wire and cable at every termination point. Identify all conduits with “neat” colour bands at no more than 7.5 m intervals and on both sides of walls and floors.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

.2 Locations: In conspicuous location to facilitate easy reading and identification from operating floor.

.3 Protection: Do not paint, insulate or cover in any way.

.4 All plug-in components shall be labelled such that removal of the component does not remove the label.

3.2 EXISTING PANELS

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

.2 Where new points are added or where controllers are replaced, all cabling, wiring, and device tags shall be updated as required and as built drawings shall be issued.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 NOT USED

Part 3 Installation

3.1 INSTALLATION STANDARDS

.1 The intention of this clause is to guide the Contractor as to the required quality of installation.

.2 All installations shall be performed by skilled certified technicians and trades people and meet the existing building and DFO standards in all aspects.

.3 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.4 Contractor shall continually monitor the installation for code compliance and quality of workmanship.

.5 Contractor shall arrange for field inspections by local and/or Provincial authorities having jurisdiction over the Work.

.6 Equipment shall be installed to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.7 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation and with no condensate traps.

.8 Cooperate with the construction team as a whole, to keep the job reasonably clear of waste material and rubbish at all times during progress of the work. In occupied areas. Clean-up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.9 Installation of equipment in occupied areas must take place outside of regular business hours. Desks, equipment and furniture must be covered when the work is taking place. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Owner's Representative.

.10 Keep existing building in operation at all times with minimum length of shutdown periods. Obtain permission of the Owner before shutting down or disconnecting existing control systems, electrical and fire protection services.

.11 All points associated with a single zone or an individual system shall be connected to the same standalone panel and associated terminal unit controller.

.12 Patch and touch up paint to match existing or a provide cover plate where sensors were removed or replaced by new DDC sensors.

3.2 ELECTRICAL WORK BY THE CONTROLS CONTRACTOR

.1 All wiring required for devices supplied under this Specification, regardless of the voltage, shall be the responsibility of the Controls Contractor.

.2 Provision of control panels, pilot lights, selectors, relays, etc., required for the proper operation of the control systems.

.3 Conduit and wiring from the starter control circuits to the mechanical system control panels including 110 V wiring.

.4 Conduit and wiring required for the interlocking of mechanical system motor starters as required for the proper operation of the control system.

.5 Wiring from pilot devices, relays, contactors, or other control interface devices required for the proper operation of the control system.

.6 Wiring from spare 15 amp circuit breakers in power panels for line voltage power sources where required by control system. Circuit breakers shall be locking type.

.7 Power wiring and control wiring to stand alone panels and terminal unit controllers.

.8 Controls Contractor shall confirm all wiring connections between controllers and field devices and provide a copy of the End-to-End Checkout Sheet for every control panel.

.9 Controls Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with termination identified at the job site.

.10 Wiring of mechanical component controls, i.e., air handling units, heat pumps, etc.

3.3 CONTROL AND INTERLOCK WIRING

.1 All control and interlock wiring shall comply with the national and local electrical codes as well as the following clauses.

.2 All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

.3 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with local codes.

.4 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

.5 Adhere to Division 26 requirements for installation in raceways.

.6 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical

trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

.7 Where there is no alternative to supplying equipment that is not CSA certified, submit such equipment to Inspection Authorities for special inspection and obtains approval before delivery of equipment to site. Such equipment must be individually identified in the Contractor's proposal.

.8 Use coded conductors throughout with different coloured conductors for each phase and white wire for neutral.

.9 All wiring in mechanical rooms and service rooms shall be in conduit or raceway. Provide 600 mm, B-X flexible connection to input and output devices where required for servicing or to accommodate vibration.

.10 Identify each wire and cable at every termination point. Identify all conduits with "neat" colour bands at no more than 7.5 m intervals and on both sides of walls and floors.

.11 Low voltage wiring to input and output devices from Building Controller and Application Specific Controllers is not required to be installed in conduit except as noted. Use plenum rated wire in areas used as return air plenums. Provide sleeves where wires pass through walls and floors. Support wires from structure or fixed equipment in ceiling spaces at minimum 2 m intervals.

.12 Junction and Pull boxes shall be adequate tagged to indicate its use for DDC system. Self sticker labels with controls company logo could be used for that purpose.

3.4 COMMUNICATION WIRING

.1 Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run inside conduit and separately from other wiring.

.2 All communication wiring between main Building Controller and the Operator Interface shall be installed in conduit.

.3 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.4 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks to for stable and less network communication errors.

.5 All exposed connection for external communication device as modem, laptop, etc. shall terminate with a utility box with a faceplate with CAT5 connector.

3.5 WIRELESS NETWORK

.1 The Ethernet communication between the DDC controllers and Operator Workstation installed in separated buildings shall be wireless using a point to point RF modems and antenna suitable for reliable communication between the buildings.

.2 Provide RF modem as follows:

.1 128 bit encryption for secure data delivery;

.2 No interference with Wi-Fi networks;

.3 1.5 Mbps or higher data transmission rate;

.4 Operating temperatures of -40°C to 50°C;

.5 900 MHz licence-free ISM communication band

.6 Reference: XPress Ethernet Bridge

3.6 CLASS 1 WIRING

.1 120 V circuits shall be, at a minimum, of #12 AWG RW-90 copper. For runs over 50 m in length, use #10 AWG RW-90 copper.

.2 All 120 V interlock wiring and power supplies for panels to be installed in conduit.

.3 Provide 120 V power supplies to all main DDC panels, separately circuited from all other loads.

.4 Several Application Specific Controllers may be supplied from one 120 V power supply through a 120/24V transformer in accordance with the manufacturer's design. Only Application Specific Controllers connected to the same Building Controller may be connected to a common power supply.

3.7 CLASS 2 WIRING

.1 24 VAC power to controllers shall be separated from field devices transformer.

.2 Size and type of low voltage control signal wiring shall be suitable for the service for which it will be put to use and be the responsibility of this Contractor; minimum of #18 AWG RW-90 stranded copper conductors.

.3 Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

.1 Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

.2 All cables shall be UL listed for application, i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose.

.4 Any existing wiring considered for re-use (i.e. thermostat wiring re-use for temperature sensor) must be fully tested and verified prior to connection to new system. Any wiring deemed to not meet the project requirements must be replaced at the cost of the contractor.

.5 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

.6 Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

.7 All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block.

.8 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

3.8 INSTALLATION OF SENSORS

.1 Install sensors in accordance with the manufacturer's recommendations.

.2 Mount sensors rigidly and adequate for the environment within which the sensor operates.

.3 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

.4 Sensors used in mixing plenums shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct with each bend supported with a capillary clip.

.5 Immersion temperature sensors shall be installed in such a manner to allow the sensing element to be truly indicative of the medium temperature. Sensors shall be installed in wells with heat conducting compound and fastened into the well with fittings designed for the purpose.

.6 Supply approved thermal wells of the appropriate size and type for sensing water temperatures, as required in the Points List, to the mechanical contractor for installation.

.7 Strap-on type sensors shall be installed with thermal conducting compound and stainless-steel band clamp.

.8 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

.9 Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

.10 Duct static pressure sensing tip shall be located so as to properly sense the static pressure in the duct without being adversely affected by changes in flow from duct fittings. Locate sensing tip a minimum straight duct length of 6 duct diameters upstream and 4 duct diameters downstream from any duct takeoff or elbow fittings.

.11 Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

.12 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

.13 Install labels on the inside covers of all room sensors identifying the point name using peel and stick labels.

3.9 INSTALLATION OF PRESSURE TRANSDUCERS

.1 Install transducers in accordance with the manufacturer's recommendations.

.2 Mount transducers rigidly on a wall or on a vertical surface with the pressure ports and cable entrance on the bottom. Avoid locations with severe vibrations or excessive moisture. Ensure there is enough space around the unit to make the pressure and electrical connections.

.3 Transducers shall be provided complete with 3-way manifold valves provided by the manufacturer.

.4 Pressure probes shall be installed perpendicular to the piping. Probes installed in horizontal pipes shall not be installed at the top or the bottom of the pipe to avoid air or dirt contamination going to the sensor. Allow minimum 6 pipe diameter upstream and downstream of the probe for the location.

.5 Line/tubing connection to the transducer shall be in copper tubing and not plastic.

.6 Air duct static pressure sensing tip shall be located so as to properly sense the static pressure in the duct without being adversely affected by changes in flow from duct fittings. Locate sensing tip a minimum straight duct length of 6 duct diameters upstream and 4 duct diameters downstream from any duct takeoff or elbow fittings.

.7 Install labels on the inside covers of all sensors identifying the point name using peel and stick labels such as the Brother labelling system.

3.10 INSTALLATION OF DAMPER ACTUATORS

.1 Mount and link control damper actuators per manufacturer's instructions.

.2 Where damper motors operate outdoor relief, exhaust and fresh air dampers, pretension damper drive linkage to ensure tight closure.

.3 To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5% open position, manually close the damper, and then tighten the linkage.

.4 Do not install damper motors on ductwork of less than 0.76 mm thick without reinforcement.

.5 Where a damper motor is installed on an insulated surface of a duct plenum, mount it on a stand-off bracket so as not to interfere with the continuity of the insulation.

.6 Actuators shall be easily removed for replacement.

.7 Locate actuators so that they are easily accessible for testing and servicing.

.8 Damper motors shall be selected for the torque requirements of the damper. Damper operators that are undersized for the application shall be replaced with larger operators, at no extra cost.

.9 Provide one damper motor and linkage for every 2 m2 damper section area, or as required to meet the torque requirements of the damper under design air-flow conditions (or minimum of one damper motor per damper section). Do not use two motors linked together on one shaft, or by jackshaft.

.10 Check operation of the damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

.11 When replacing existing integral unit economizers with DDC controlled mixing air damper actuators, all unused devices including economizer controller, dampers actuator, relays, and associated wiring shall be removed to not interfere with the DDC operation.

3.11 INSTALLATION OF FLOW SWITCHES

.1 Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.

.2 Mount a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 2 feet which ever is greater, from fittings and other obstructions.

.3 Install in accordance with manufacturers instructions.

.4 Assure correct flow direction and alignment.

.5 Mount in horizontal piping - flow switch on top of the pipe.

3.12 INSTALLATION OF PRESSURE AND DIFFERENTIAL PRESSURE SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.2 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.13 INSTALLATION OF RELAYS

.1 Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

.2 All relays to be tagged indicating DDC controller, point and function. All plug-in relays shall be labeled such that removal of the component does not remove the label.

3.14 INSTALLATION OF CONTROLLERS

.1 Other equipment controllers shall be mounted inside enameled steel, fully enclosed NEMA 1 construction control cabinets with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.

.2 Controllers and devices shall be conveniently spaced and neatly wired. Cables shall be accommodated inside slotted plastic wiring duct.

.3 Input and output point wiring shall have an extra length of 50cm (1.5ft) for future panel retrofit.

.4 Panels shall have an additional 20% free face area space to accommodate additional control devices.

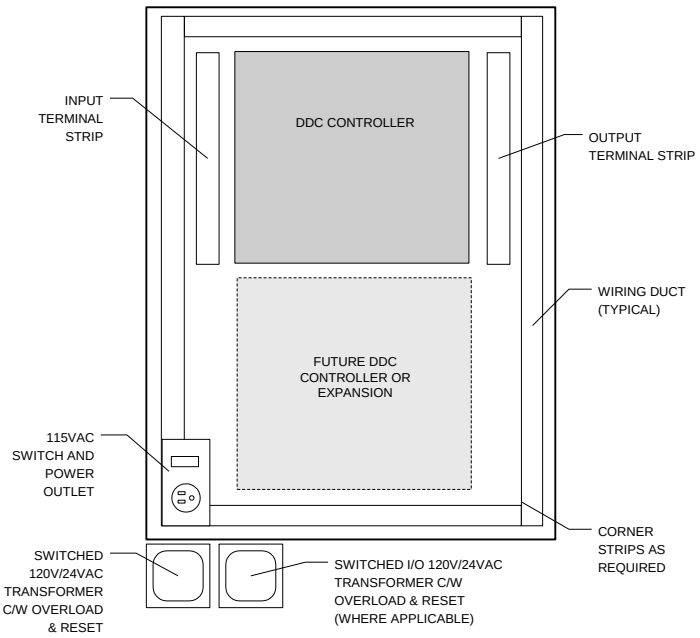
.5 Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

.6 All points associated with a single zone or an individual system shall be connected to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

.7 The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

.8 Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

DDC CONTROL PANEL TYPICAL LAYOUT



.9 Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

.10 Building Controllers shall have the I/O points powered from a separate transformer to maintain the sub-network communications over an I/O device short circuit.

3.15 CONTROL PANELS

.1 Control panels shall be installed in accessible locations for ease of service.

.2 Panels mounted inside mechanical rooms and other wall mount locations shall be mounted at 1.5m from floor.

.3 Control panels mounted above dropped ceilings shall be located in corridors provided the resulting average wire length is less than 10m.

.4 Control panels shall not obstruct service access to equipment.

.5 A copy of the related as-built systems schematics, points list, and sequences of operation shall be placed inside each control panel. Points list shall be laminated and affixed inside the control panel door.

3.16 WARNING LABELS

.1 Affix plastic labels on each starter and equipment automatically controlled through the Control System. Label shall indicate the following:

```
C A U T I O N

This equipment is operating under automatic control
and may start at any time without warning.
```

3.17 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information. Cable identifier shall be shown on and match record documents.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served.

.3 Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

.4 Identify all other control components including control relays with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

.5 Where new points are added or where controllers are replaced, all cabling, wiring, and device tags shall be updated, as required and as built drawings shall be issued.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

1.2 COMMUNICATIONS

.1 The data communication protocol for the project shall comprise a BACnet inter-network. The PC Workstation and Building Controller components shall meet ASHRAE / ANSI Standard 135-2016, BACnet - A Data Communication Protocol for Building Automation and Control Networks

.2 Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in Section 25 30 01.

.3 The communication between the Building Controllers (B-BC), and Advanced Application Controllers (B-AAC) / Application Specific Controllers (B-ASC) shall be via BACnet MS/TP networks. Arcnet, Lon or other protocols are not acceptable.

.4 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.5 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks.

.6 The Controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

.7 All Building Controllers shall have a communications port for connection with operator interfaces. This may be either an RS-232 port for Point to Point connection or a network interface node.

.8 Ethernet network connections shall be provided in each mechanical room for laptop connection. Ethernet connector shall be installed inside the control panel or in a utility box adjacent to a control panel with faceplate mounted Ethernet jack.

.9 Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:

.1 Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.

.2 All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An

operator/installer shall not be required to set up any communications services to perform inter-network value passing.

.3 The time clocks in all controllers shall be automatically synchronized daily.

.4 The Ethernet network shall be extended to all supervisory controllers, operator workstation and data server.

.5 Networks connecting zone level controllers such as re-heat systems, etc. shall be directly connected to the DDC controller controlling the associated air handling unit.

1.3 INFORMATION ACCESS PROTOCOL

.1 The Operator Workstation shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.9, respectively, of ASHRAE Standard 135-2016, to communicate with BACnet objects in the internetwork.

1.4 INPUT/OUTPUT INTERFACE

.1 Hardwired inputs and outputs may tie into the system through Building, Custom, Application Specific Controllers or Lighting Controllers.

.2 All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

.4 Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation and shall be protected against effects of contact bounce and noise.

.5 Analog inputs shall allow the monitoring of low voltage (0-10 VDC), current (4-20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

.6 Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on Custom and Building Controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

.7 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.

.8 Occupant adjustment of space temperature setpoint at network thermostats shall be limited to ±1.5ºC of nominal value unless otherwise specified.

1.5 SYSTEM GRAPHICS

.1 The Operator Workstation software shall be graphically oriented. The system shall allow display of multiple graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen.

.2 An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.

.3 Graphic screens:

.1 Graphic screens shall be provided for main menu, weekly / holiday schedules, network schematic, floor plans, and for each HVAC system schematic and equipment.

.2 Main Menu shall display general information of the building and the DDC system. From the main menu navigation buttons should direct to each floor, to main HVAC systems such as chilled and hot water plants, and to the scheduling and network schematic screens.

.3 Scheduling graphic screen shall be created to allow the building operator to access and adjust all weekly schedules set for the building (by floor, zone, tenant, etc), Annual (Holiday) Calendar, and Exception Schedule.

.4 Floor plan graphics screens shall be created and reflect correct zoning such as areas served by air handling units and heat pumps. The numbers shall be the same as the equipment tag numbers. Floor graphic screen shall include zone temperatures, setpoints and links to equipment serving the floor. Where a modulating valve serves a zone the valve commanded position shall also be shown

.5 A graphic screen shall be provided for each air handling system with a table showing all associated VAV boxes. Graphic screen shall display air handling unit supply air temperature and a table with columns indicating, room temperature, room temperature setpoint, current AHU-3 airflow.

.6 Graphic screens shall be created for each piece of equipment such as air handling units, fan coils, boilers, etc displaying all associated inputs/outputs/setpoints.

.7 Building Network Diagram graphic screen shall be provided showing each controller and network panel complete with tag, address, controller make and model and installed location.

.4 Screen Navigation:

.1 A menu bar shall be located at the bottom of each graphics screen. The menu bar and menu buttons shall be placed at exactly the same location on each graphic screen to allow browsing through the system by clicking on the buttons without moving the mouse.

MAIN MENU: Clicking the Main Menu button, in the left most position on the menu bar on all graphic screens, shall open the main menu graphic screen;

PREVIOUS: Clicking the Previous button, the second from the left position on the menu bar on all graphic screens, shall open the graphic screen most recently displayed prior to the currently graphic;

CUSTOM: One or more buttons for commands specific to the currently displayed graphic screen;

HELP: Clicking the Help button, located on the right most position of the menu bar on all graphic screens, shall open the help graphic screen;

.2 A key plan shall be provided in the lower right hand corner with each graphic screen showing the related floor area plus the number of floors or levels. The shaded area will depict the area served by the graphic. Clicking on the level or floor number will present the corresponding location on that floor graphic. Clicking on the non-shaded areas will present the graphic representing that area on the same floor.

.5 Minimum Requirements:

.1 Placement of any information or active icons close to the edge of the graphic display area shall be avoided to minimize issues when sizing windows or screen setup with monitors with various resolutions.

.2 The graphic title shall be located at the top of each screen. The outdoor air temperature shall be displayed at the top left corner of each graphics screen;

.3 Text in graphic screens should have adequate font size for visualization and pleasing color contrast between lettering and background. Where text size precludes uncluttered placement of all information on the graphic screen, an additional zoom graphic screen shall be provided;

.4 Point values or status shall be located as close as possible to the graphical representation of the actual physical location. If the point has an associated setpoint this point will be located directly below the actual point and be in a different colour;

.5 Status of equipment shall be displayed as ON or OFF and located on top of commanded points; Command points shall be defined as Start/Stop or Enable/Disable, etc, but not as ON/OFF;

.6 Operator overrides of input points or values or outputs normally under program control shall result in display an override (hand or red block) indication adjacent to the display;

.7 Weekly schedules shall be symbolized by a clock icon and be accessed from each system schematic graphic screen;

.8 All specified multiple trends shall be accessible from the associated graphic screen, labelled and have the same placement on similar graphic screens;

.9 Runtime hour icons shall be placed as close as possible to the actual point or value being totalized. The icon shall provide access to the totalizer configuration data.

.6 Colour Selection:

.1 The visual impact of color shall align with the importance of the information.

.1 Bright red or yellow block with black letters shall be used for alarm and warning information;

.2 White block with black letters shall be used for dynamic information such as temperature and status;

.3 Light blue block shall be used for adjustable setpoints;

.4 Colour consistency shall be maintained throughout - all air systems similar, all hot water lines the same colour, all chilled water lines the same colour; return lines colour should be shown in a lower grade than the supply line.

.5 Colour selections shall provide legible gray scale outputs on printers.

.7 Output Scaling:

.1 Information on position of 3-state (incremental) actuators should be displayed as open percentage and not as a position of each binary output (OPEN: ON/OFF; CLOSE: ON/OFF)

.2 All analog output values for control of pneumatically actuated valves and dampers shall be scaled and limited to 0 to 100% open for display on graphic screens.

.8 Variables

.1 All variables specified as adjustable or configurable shall be configured as BACnet Analog Value objects. Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition.

.2 All variables specified as fixed shall be imbedded in control programs and shall not be configured as BACnet objects.

.3 Variable names shall be defined as an acronym representing the use of the variable in the program. The variable description field shall be used to provide additional information about the variable.

.9 Trending:

.1 System schematic graphic screens shall have as many trend /multi-trend icons as required in the specification linked to the specific trend graphic screen. Trend icons should have explanatory title and be placed on left upper corner of the screen.

1.6 ENGINEERING UNITS

.1 Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be SI

1.7 PROGRAMMING

.1 Provide programming for the system as per specifications and adhere to the control sequences provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.2 All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

.3 Points Naming Convention:

.1 Create and name all points indicated in the points lists. Software points (variable) shall have the same characteristics on the graphic screens as the real or hardware points. A few additional points may be required to comply with the intent of the generic logic, depending on the vendors system.

.2 System point names as point, variable, trend, schedule, calendar and other names shall be modular in design, allowing easy operator interface without the use of a written point index.

.3 Point naming shall be composed as follows:

SITE_BLDG_SYS_POINT_FUNC

Where:

SITE is the site identifier

BLDG is an optional building identifier (applied where applicable)

SYS is the system identifier

POINT is the point identifier(s)

FUNC is the point function

Alternative for Retrofit Project:

.4 System names as points, variables, trends, schedule, calendar and other names shall be modular in design, allowing easy operator interface without the use of a written point index.

.5 Control points shall be named in as per existing convention.

.4 Variables:

.1 All variables specified as adjustable or configurable shall be configured as BACnet Analog Value objects. Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition.

.2 All variables specified as fixed shall be imbedded in control programs and shall not be configured as BACnet objects

.3 Provide a description for each analog and binary variable created. The description property shall include application and scope of the variable.

.4 Variable names shall be as defined as an acronym that represents the application of the variable. All variable description fields shall provide information as to the variable application. (ie. Upper range limit for static pressure reset, outside air temperature below which maximum supply water temperature setpoint is applied, boiler is disabled above this temperature)

.5 Provide programming for the system as per specifications and adhere to the control sequences provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor.

.6 Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.7 The term "proven" (i.e. "proven on"/ "proven off") shall mean that the equipment's digital input (DI / BI) status point matches the state set by the equipment's digital output (DO / BO) command point.

.8 Where fan status is determined based on current measurement, the threshold shall be established to indicate belt failure.

1.8 SCHEDULING AND OPTIMAL START

.1 Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member.

.2 Each schedule shall consist of the following:

.1 Daily Schedule: Provide hourly scheduling blocks that allow multiple schedules during each day.

.3 Weekly Schedule: Provide separate schedules for each day of the week.

.4 Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.

.5 Holiday Schedules: Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

.6 Optimal Start/Stop: The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

1.9 CONTROL LOOPS

.1 A PI (proportional-integral) algorithms with direct/reverse action, anti-wind-up and deadband as applicable shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, setpoint, PI gains and deadband shall be user-selectable. The setpoint shall optionally be chosen to be a reset schedule.

.2 Provisions shall be made to ensure that systems perform an orderly start-up without excessive temperatures, flows, pressures etc.

.3 Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up or shall be forced to a condition which applies minimum control effect.

.4 Unless specifically indicated otherwise:

- Proportional only (P) loops shall be used for limiting loops (such as mixed air low limit control loops, minimum evaporator flow, etc.).
- Derivative terms shall not be used unless proven to be required during field tuning.

.5 Separate gains shall be used for each device where control is effected by staging multiple devices utilizing a single output (split range control). Gains shall be determined by the Contractor to provide stable control. If this is not possible, the operating range of each device shall be adjusted to provide stable control.

.6 All control loops shall be tuned to provide stable and responsive control.

1.10 ALARMS AND ALARM REPORTING

.1 Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

.2 The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations, e-mail accounts and cellular phones.

.3 The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using web-based communications.

.4 The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

.5 Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.

.6 Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

.7 Adequate range, time delay and interlocks shall be provided to avoid nuisance alarms caused by changes of state or normal temperature recovery period.

.8 The alarm message shall be clear and provide enough information for the operator to determine the action to be taken in the event of an alarm. It shall include the name of the calling location, the device that generated the alarm, and the alarm message itself.

.9 The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All alarms that have not been cleared by the operator shall be archived to the hard disk on the workstation.

.10 There shall be 5 levels of alarm:

Alarm Level	Alarm Type	Notification Devices		
		Operator Interface	Alarm Printer	Cell Phone
1	Critical/life safety	X	X	X
2	Significant equipment failure	X	X	X
3	Non-critical equipment failure/operation	X	X	
4	Energy conservation monitor	X		
5	Maintenance notification	X		

1.11 TREND LOGS

.1 The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, type of collection (polling or COV), start-time, and stop-time. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk.

.2 Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format and able to be exported for use by other industry standard word processing and spreadsheet packages.

.3 Trend Log Object and Trend Log Multiple Object Types shall be as defined in Clauses 12.25 and 12.30, respectively, of ASHRAE Standard 135-2008.

.4 Trend axis shall be labeled with applicable units. Variable shall be assigned to an axis based on expected range and/or units.

.5 Trends logs shall be configured as per section 25 90 01 – EMCS Systems Sequences of Operation for each I/O point for 300 samples at 15-minute intervals.

1.12 OVERRIDDEN POINTS REPORT

.1 Overridden Points Report shall be created and available for the operator use

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 - ECMS General Requirements

Part 2 Products

2.1 OPERATOR INTERFACE (B-OWS)

.1 Contractor shall provide a local PC based operator workstation able to access all information in the DDC system. The operator workstation shall be installed in the Mechanical room mounted on a wall shelf and locked to the wall/floor.

.2 Operator workstation shall be as appropriated for the DDC system and meet the following minimum hardware requirements:

.1 2.0 GHz or higher processor;
.2 RAM – Min. 4 GB;
.3 Hard Drive – 500 GB, 7200 rpm SATA;
.4 Video Card – On-Board min 1 GB;
.5 Network Card – Ethernet (802.3) 100/1000 Mb/sec;
.6 A minimum of 2 front and 2 rear access USB ports;
.7 DVD RW ROM drive;
.8 Monitor – 19" LCD ViewSonic, or equivalent Samsung or Dell;
.9 Keyboard – Standard 105-key keyboard;
.10 Mouse –optical and pad;
.11 All necessary connection cables;
.12 Microsoft Windows 10 with license.

2.2 WEB SERVER (B-OWS)

.1 The Controls Contractor shall provide a Web server able to access all information in the system. The web server shall be located in the existing Building Operator's Office.

.2 The Web Server shall provide password protected Internet access from any computer and tablet such as IPad using web browsers such as Internet Explorer, Chrome, IPad/IPhone Safari, and Firefox. All graphic screens shall reside in the Web Server.

.3 DDC remote access, providing user has adequate password, shall provide all appropriate data and control functionality, including the ability to make changes to controller program code in all network panels and controllers.

.4 Provide and install router / switches / modem and associated cables as required for remote communication to the existing building control system on the Base. Coordinate with IT personnel for remote access to the DDC system via Internet;

2.3 CONTROLLERS

.1 The following requirements shall apply to Building Controllers (B-BC), Advanced Application Controllers (B-AAC) and Application Specific Controllers (B-ASC):

.2 Controllers shall be native BACnet. No translation software shall be used internal to the controller to convert from a proprietary protocol to BACnet Standard Object Types, Standard Application Services and Devices. Gateways are not native BACnet.

.3 Effective Panel Processing Speed - Maximum permissible execution time is half a second. Execution time is defined as the time it takes the controller to execute all application software from some point in the software back to the same point while simultaneously responding to operator or terminal display requests and carrying out normal inter-panel communications. Set up an analog variable counter in each controller, incremented and reset by program code, to allow for verification of the processing speed.

.4 Controllers shall have sufficient memory to support its operating system, database, programming and trending requirements. There shall be a minimum of 50% available memory free for future use.

.5 Controllers shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

.6 Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

.7 Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m.

.8 Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

.9 Controller hardware shall be suitable for the anticipated ambient conditions.

.10 Controllers used in conditioned ambient shall be mounted in NEMA 1 Type rated enclosures, and shall be rated for operation at 0°C to 50°C.

.11 Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 Type waterproof enclosures, and shall be rated for operation at –40°C to 65°C.

.12 Controllers that perform scheduling shall have a real time clock.

2.4 BUILDING CONTROLLERS

.1 The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global control strategies specified in the Sequences of Operation section of the Specifications

.2 Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Advanced Application and Application Specific Controllers.

.3 The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-2004, to communicate with BACnet objects in the inter-network.

.4 The controller shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical/data link layer protocol or a connection to the inter-network.

.5 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

.6 Data shall be shared between networked Building Controllers on a peer-to-peer basis.

.7 The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

.1 assume a predetermined failure mode;

.2 generate an alarm notification.

.8 The building controllers shall be able to communicate with and download programs to Application Specific Controllers.

2.5 ADVANCED APPLICATION CONTROLLERS

.1 Advanced Application Controllers shall perform the control strategies specified in the Sequences of Operation section of the Specifications. Each of these panels shall meet the requirements as outlined in this section.

.2 The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Advanced Application Controllers to manage the local strategies described in System software section.

.3 Controllers that perform scheduling shall have a real time clock.

.4 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

.5 Data shall be shared between networked Controllers.

.6 The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

.1 assume a predetermined failure mode;

.2 generate an alarm notification.

.7 The Advanced Application Controller shall communicate with other BACnet devices on the inter-network using the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-95.

.8 Each controller shall reside on a BACnet network using a MS/TP Data Link/Physical layer protocol.

.9 The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol to a portable operator's terminal.

2.6 APPLICATION SPECIFIC CONTROLLERS (B-ASC)

.1 Application Specific Controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

.2 Application Specific Controllers can be used as individual controllers in applications such as VAV Boxes, Fan Coil Units, Heat Pump Units, and for discrete I/O points monitoring.

.3 Application Specific Controllers shall perform the control strategies specified in the Sequences of Operation section of the Specifications. Each of these panels shall meet the requirements as outlined in this section.

.4 Each ASC will contain sufficient I/O capacity to control the specific system.

.5 Each ASC shall be able to receive a download of its program from the Building Controller.

.6 The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol to a portable operator's terminal.

.7 Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable modular terminal strips.

.8 Each controller shall reside on a BACnet network using a MS/TP Data Link/Physical layer protocol.

.9 Each network of application specific controllers controlling VAV boxes, re-heat systems, etc shall be directly connected to the Building Controller controlling the associated air handling unit.

.10 Several Application Specific Controllers may be powered from one 120/24VAC transformer in accordance with the manufacturer's design. Transformers shall be located inside mechanical rooms for easy access. Only controllers that are connected to the same Building Controller shall be connected to a common power supply.

Part 3 Execution

3.1 Not used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 CONTROL DAMPERS

.1 Provide control damper as follows:

.1 Control dampers shall meet the performance requirements indicated in the Mechanical Equipment Schedules.

.2 Control Dampers shall be parallel or opposed blade type as scheduled on drawings and shall be constructed as described in this section.

.3 Damper frames shall be 16-gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.

.4 Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.

.5 Damper shaft bearings shall be as recommended by manufacturer for application.

.6 All blade edges, top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.

.7 All leakage testing and pressure ratings will be based on AMCA Publication 500.

.8 Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

2.2 ELECTRONIC DAMPER/VALVES ACTUATORS (DAx & CVx)

.1 Provide damper/valve actuators as follows:

.1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.2 Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

.3 All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.

.4 Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range.

.5 All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

.6 All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation

.7 Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

.8 Actuators shall be Underwriters Laboratories Standard 873 listed.

.9 Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

.10 Actuators shall allow smooth operation throughout entire operating range and assure tight shut-off against system pressure.

.11 Provide position indicators on volume control dampers.

.12 Actuators shall remain stationary until the applied signal changes.

2.3 CONTROL VALVES

.1 Control valves for plant equipment shall be two-way or three-way type for two-position or modulating service as scheduled or shown. Control valves for zone control may have modulating or floating point control.

.2 Where CV is specified in the points list or on a valve schedule, ensure the control valve has a similar CV to that specified.

.3 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

.4 Water Valves:

.1 two-way: 150% of total system (pump) head;

.2 three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

.5 Steam Valves:

.1 150% of operating (inlet) pressure.

2.4 TEMPERATURE SENSORS

.1 Provide one of the following temperature sensor types throughout:

.1 10,000 Ohm at 25°C thermister

.2 1000 Ohm at 0°C (±0.2 ohm) thin film platinum with coefficient of resistivity of 0.000385 ohms/ohm/°C

.3 100 Ohm at 0°C (±0.2 ohm) platinum with coefficient of resistivity of 0.00385 ohms/ohm/°C

.2 Sensors shall have an accuracy of ±0.3 C or better.

.3 All temperature sensors provided shall be constructed in a strain minimizing construction with integral anchored lead wires

2.5 IMMERSION TEMPERATURE SENSORS (TSP1)

.1 Provide, spring-loaded, thermowell mount sensors as follows:

.1 stainless steel sheath;

.2 spring loaded construction complete with compression fitting for 20 mm or 12 mm NPT well mounting as applicable;

.3 length as suitable for the application;

.4 standard conduit box termination, complete with screw terminal connector block.

.2 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well to be consistent with the system pressure in which it is to be installed.

2.6 STRAP-ON TEMPERATURE SENSORS (TSP2)

.1 Provide "strap-on" type sensors having the following minimum specifications:

.1 non-corroding (brass) sheath construction;

.2 standard conduit box termination complete with screw-terminal connector block;

.3 complete with stainless steel pipe clamps;

.4 installed with heat transfer paste so as to provide a good thermal and mechanical bond with the associate pipe work;

.5 replace and restore all pipe-wrap and insulation, as disturbed by the installation, to its original condition.

2.7 DUCT AVERAGING TEMPERATURE SENSORS (TSD1/x)

.1 Provide duct averaging type temperature sensors as follows:

.1 Copper sheathed construction.

.2 Internal parallel/series network of multiple sensing elements encapsulated at equal distances along the length.

.3 Unless otherwise specified, a minimum of four internal sensing elements shall be used for sheath lengths less than 7 m. For lengths greater than 7 m - nine sensing elements shall be used.

.4 Location of each internal temperature sensing element shall be clearly indicated.

.5 Standard conduit box termination complete with screw terminal connector box.

.6 Probe to be capable of being formed, at field installation time, to a minimum radius of 10 cm at any point along the probe length other than within 20 cm of the connector box with no degradation to the specified performance.

2.8 DUCT MOUNTED TEMPERATURE SENSORS - (TSD2)

.1 Provide general purpose duct mount temperature sensors as follows:

.1 Copper sheathed construction

.2 Standard conduit box termination, complete with screw terminal connector block

.3 Length to extend, at minimum, one-third of the distance across the duct

2.9 ROOM TEMPERATURE SENSORS (TSR/TSR1/TSR2/TSR3)

.1 Provide room temperature sensors as follows:

.1 For non-security applications (TSR/TSR2/TSR3) the sensing element shall be installed in a vented wall mounted protective enclosure.

.2 For security applications (TSR1) the sensing element shall be attached directly to a rigid, metal cover plate designed for mounting into a recessed junction box.

.3 Equipped with set-point adjustment, override switch, display, and/or communication port as shown on points list.

2.10 OUTSIDE AIR TEMPERATURE SENSORS (TSO)

.1 Provide outside air temperature sensors as follows:

.1 weather proof enclosure complete with on-corroding outdoor shield designed to minimize the effect of solar heating on the sensing element;

.2 threaded fittings for mating to 12 mm conduit or as applicable;

.3 total probe length of 50 mm;

.4 stainless steel sheath;

.5 operating range: -35°C to +50°C.

2.11 ELECTRO-PNEUMATIC TRANSDUCERS (EPT)

.1 Electric/pneumatic transducers shall have the following characteristics:

.1 provide a proportional 20 to 100 kPa (3 to 15 psig) output signal from either a 4 to 20 mA or 0 to 10 VDC analog control input;

.2 equipped with separate span and zero adjustments

.3 equipped with an output pressure gauge assembly;

.4 Linearity: +/- 1% of span maximum;

.5 Hysteresis: 0.75% of span maximum;

.6 Mounting: Supplied with track or brackets for panel mounting.

2.12 HIGH LIMIT THERMOSTATS

.1 Safety high limit thermostats shall have the following characteristics:

.1 vapor pressure type with capillar and bulb;

.2 thermowell: stainless steel, with compression fitting.

.3 adjustable setpoint and differential.

.4 manual reset.

.5 accuracy: plus or minus 1ºC.

.6 range: 30°C to 70°C.

.7 DPDT switch.

.8 Snap action rating: 120V, 15 amps or 24V DC as required.

.2 Main switch shall be hardwired to shutdown the pump and close the heating valve (fail safe mode).Auxiliary switch shall be wired to DDC input for alarm.

2.13 FLOW SWITCHES (PADDLE)

.1 Flow-proving switches shall have the following characteristics:

.1 Paddle type switches are for water service only;

.2 SPDT snap-acting with pilot duty rating (125 VA minimum);

.3 Adjustable sensitivity;

.4 CSA/UL listed;

.5 NEMA 1 Type enclosure unless otherwise specified;

.6 The paddle size and length to be cut as per the manufacturer's recommendation for the pipeline size and flow.

2.14 PRESSURE SWITCHES (PS)

.1 Provide pressure switches as follows:

.1 setpoint adjustment over, at minimum, 80% of the operating range;

.2 deadband adjustment down to, at maximum, 10% of the operating range;

.3 SPDT switch action;

.4 shock and vibration protection as necessary;

.5 internal materials of the switch as suitable for the application.

2.15 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Provide differential pressure transmitters as follows:

.1 Solid-state design, operating on capacitance principle

.2 Range selected to suit application

.3 Internal materials of the transducer suitable for the application

.4 Integral filters at each air connection port

.5 Integral, accessible non-interactive zero and span adjustment

.6 Minimum operating range of 0°C to 50°C with 20% to 90% RH (non-condensing)

.7 Accuracy of ±1% range including non-linearity and hysteresis

.8 Over pressure input protection as necessary for the application

.9 Shock and vibration protection as necessary

2.16 CONTROL RELAYS (CR1, 2, 3, crs)

.1 Provide control relays as follows:

.1 Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

.2 Electro mechanical relays shall have integral override switch to allow local override in event of DDC Control failure.

.3 Motor rated relays shall be provided in DDC Enable application for small motors (pumps, fans, etc.) with manual starters.

.4 Provide NEMA 1 Type enclosure when not installed in local control panel.

2.17 CURRENT TRANSDUCERS (CS1)

.1 Provide current transducers as follows:

.1 range selected to match the current of the application;

.2 output to match the requirements of the DDC System;

.3 accuracy of ± 2% full scale or better;

.4 repeatability of ±2% full scale or better;

.5 over-current and over-voltage protection as applicable;

.6 shock and vibration protection as necessary.

2.18 DAMPER END SWITCH (ES1)

.1 Provide Damper End Switches as follows:

.1 Switch shall be mechanically actuated

.2 Switch shall provide indication for fully open and fully closed.

.3 End Switch shall be mounted on damper drive axle or auxiliary axle off an indirectly drive blade.

2.19 TRANSFORMERS AND POWER SUPPLIES

.1 Provide control relays as follows:

.1 Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

.2 Unit shall operate between 0°C and 50°C.

.3 Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Unit shall have built-in over-voltage protection.

.4 A single transformer limited to a Class 2 (100VA) transformer could be used to power several VAV box controllers. Transformers shall be located inside the air handling unit mechanical room.

2.20 FIELD DEVICE TYPES

.1 Field devices, specifications shall be based on the following device types as noted in points lists and/or drawings.

Table 1: Control Device Types

Device Type	Description	Technical Performance
CR1	Control relay (Dry contact electro-mechanical relay)	240V, 10 amps rated capacity. SPST function. Normally open (or normally closed) as required by points list or application
CR2	Control relay (Dry contact electro-mechanical relay)	240V / 10A rated to suit application
CRS	Control Relay Status (used for status if there is no auxiliary dry contact on the equipment).	High impedance relay to produce a dry contact.
EPT	Electronic to Pneumatic Transducer	4 - 20mA / 0 - 10 VDC input signal / 21 - 103 kPa (3 - 15 psig) pneumatic output; zero and span adjustment potentiometers; 0-30 psig pressure gauge
CS1	Current Transducer	
CS2	Current Switch	
CV5	Control Valve Actuator Retrofit Kit (two position, non-spring return)	Install a DDC actuator retrofit kit to match existing valve size Power Voltage 24 VAC or 120 VAC Control Voltage 0-10 VDC
DA1	Damper Actuator (Electric, modulating, non-spring-return)	Power Voltage 24 VAC or 120 VAC Control Voltage 0-10 VDC DC brushless motor with overload protection Use the required number of actuators to provide enough torque to control the existing damper

Device Type	Description	Technical Performance
DA2	Damper Actuator (Electric, modulating, spring return)	Power voltage 24 VAC or 120 VAC Control Voltage 0 - 10 VDC DC brushless motor with overload protection Use the required number of actuators to provide enough torque to control the existing damper
DA3	Damper Actuator (Electric, 2-position, non-spring-return)	Power Voltage, 24 VAC or 120 VAC Use the required number of actuators to provide enough torque to control the damper
DA4	Damper Actuator (Electric, 2-position, spring return)	Power Voltage, 24 VAC or 120 VAC. Use the required number of actuators to provide enough torque to control the damper
DA5	Damper Actuator (Electric, floating)	Power Voltage, 24 VAC Use the required number of actuators to provide enough torque to control the damper
DPTA	Differential Pressure Transmitter –Air Service	Pressure range to suit application
EPT	Electro-Pneumatic transducers	4 - 20mA / 0 - 10 VDC input signal / 21 - 103 kPa (3 - 15 psig) pneumatic output; zero and span adjustment potentiometers; 0-30 psig pressure gauge
FRZ	"Freezestat" manual reset, complete with auxiliary dry contact in order to provide a separate digital input to the DDC system.	
APS	Air Pressure switch	
TSD1/x	Duct temperature sensor, averaging	
TSD2	Duct temperature sensor	Length to extend, at minimum, one-third of the distance across the duct
TSR	Room temperature sensor	
TSR1	Room temperature sensor with momentary override switch.	
TSR2	Room temperature sensor, security type.	

Device Type	Description	Technical Performance
TSR3	Room temperature sensor complete with momentary override switch, setpoint adjustment, and display	
TSO	Outside air temperature sensor	
TSP1	Temperature Sensor, immersion type.	
TSP2	Temperature Sensor, strap-on-type.	Apply heat transfer paste between sensor plate and pipe
ES1	Damper end switch-dual switches to indicate fully open and fully closed	

Part 3 Execution

3.1 Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

1.2 NOT USED

Part 3 Execution

1.3 GENERAL

.1 Variables

.1 Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition.

.2 All variables specified as fixed shall be imbedded in control programs. Variables provided by users and used to modify operational parameters shall be adjustable on the graphics screen.

1.4 CONTROL SEQUENCES

1.5 Make-Up Air Handling Unit (AHU-3) Control

.1 General

.1 The existing paint room make up air and exhaust systems are to be replaced and upgraded to have multi-speeds and serve two functions; it provides make-up air when painting & drying and it provides overall Workshop heating when the glycol heating heat pump system cannot keep up with the heating load. In addition to providing a controls screen for AHU-3 and the variable speed drive paint room exhaust fans, an operator display and control centre is to be provided in place of the existing paint room control system.

.2 When operated in conjunction with the paint room exhaust fans, AHU-3 shall operate at "full", "half" or "1/3rd" speed as set by the operator controls. The speed of the paint room exhaust fans shall be controlled and sequenced with the speed of AHU-3 to ensure the paint room is kept under a negative pressure during all painting and drying operations. The supply air dampers shall move to pre-determined positions to ensure the air flow to the general shop area remains constant for all three air flow rates.

.3 When it is not used for painting/drying, operations, AHU-3 shall provide the second stage of heating for the general Workshop areas. The first stage of the Workshop heating shall be provided by the glycol heating heat pump and unit heater system to keep the general shop areas at a Workshop temperature.

.4 The gas fired burner controls built into AHU-3 shall be used to modulate the burner output to maintain the supply air discharge temperature. The supply air discharge temperature shall be re-set by the DDC system to maintain the room/paint room make-up air setpoints.

.5 When painting and drying the two variable speed, paint room exhaust fans and multi speed air handling unit AHU-3 shall be controlled by the paint room control systems to run sequenced painting and/or drying cycles.

.6 When the glycol hating system cannot maintain the workshop heating setpoint, AHU-3 shall operate at low speed with "full heating" to provide space heating during after hours or when the paint room is not in use. Under these conditions, the shops relief air damper MD-AHU3b shall modulate open as required to relieve air to outdoors while keeping the workshop positively pressurized to 25 Pa (adjustable). At all other times the relief damper shall be fully closed

.7 When the HOA switch is in the "OFF" position, the equipment shall not operate.

.8 When the HOA switch is in the "ON" position, the equipment shall be on high speed and in "AUTO" position the equipment shall follow the control sequences.

.2 AHU-3 Speed and Paint Room Control

.1 When at a particular speed, 100%, 50% and 43% air flow, the supply air dampers MD-AHU3a, MDM-AHU3b and MD-AHU3c shall go to predetermined positions (for each of the three speeds) to maintain the air flow rate through the Workshop supply air ductwork constant for all three speeds. The balancing agent shall assist in determining the appropriate damper positions for all three speeds.

.2 The paint room controls shall use industrial switches, pushbuttons, fuses, control devices and a display screen (no touchscreens) as indicated on the drawings to provide the following modes of operation:

.3 Paint Cycle Only Mode; select this mode for painting only, then select/input size of paint job (large, medium or small, each associated with high, medium or low speed fan settings). Then select time duration (0.1 to 10 hours), confirm/set painting temperature setpoint and then engage the cycle. Display screen to show current operating mode, time remaining, AHU-3 SA temp, EF speeds, etc. to show the selected parameters and where you are relative to the overall cycle start and end times. (typical for all modes and when OFF).

.4 Paint and Dry Cycle Mode; select this mode for painting and drying, then select size of paint job (large, med, small with associated high, medium or low speed fan settings). Then select time duration for paint and dry, confirm/set Sa temp, confirm set-up and then engage the cycle.

.5 Dry Only Cycle Mode; select this mode for drying only, then select size of dry job (large, med, small with associated high, medium or low speed fan settings). Then select time duration for dry, confirm/set Sa temp, confirm set-up and then engage the cycle.

.6 Off or Standby Mode; select this mode when no painting or drying is required. AHU-3 shall operate in sequence with the HW heat pump heating system while the paint room exhaust fans shall be turned off.

.3 Alarms

.1 Provide the following alarms:

Alarm	Alarm Source	High Limit	Low Limit
Supply Temperature Extreme	SAT Sensor	SP + 5°C	SP - 5°C
Workshops Room Temperature	Room Sensors	SP + 5°C	SP - 5°C
Burner Failure Alarm	AHU-3 BACnet		
Fan Failure	AHU-3 BACnet		
Paint Rm Exh Fan 1 Failure	AHU-3 BACnet		
Paint Rm Exh Fan 2 Failure	AHU-3 BACnet		

.4 System Graphics

.1 Existing graphic screens shall be revised to indicate hot and cold deck dampers positions; supply air temperature setpoints; high and low supply air temperature limits; and minimum/average/maximum zone space temperature. Links shall be provided to trend logs, weekly schedules, floor graphic screens.

.5 Trends

.1 Provide 300 sample multiple point trends at 15-minute intervals for each zone for the following points/variables:

Trend 1:

Point	Trend Type
Zone Supply Air Temperature	Polling
Zone Supply Air Temperature Setpoint	Polling
Workshops Temperature	Polling
MD-AHU3a Damper Position	Polling
MD-AHU3b Damper Position	Polling
MD-AHU3c Damper Position	Polling

Trend 2:

Point	Trend Type
Paint Room Exh Fan 1 Speed Setpoint	Polling
Paint Room Exh Fan 1 Speed	Polling
Paint Room Exh Fan 2 Speed Setpoint	Polling
Paint Room Exh Fan 2 Speed	Polling

1.6 Glycol Heating System and HP-HW

.1 The air source glycol heating heat pump, HP-HW shall operate in sequence with the unit heaters to maintain the Workshop temperature setpoints. The temperature setpoint shall be scheduled based on occupancy with the normal occupied setpoint at 15 degrees C and an un-occupied setpoint of 12 deg. C (adjustable)

.2 The average room temperature shall be determined by a weighted average using all of the new temperature sensors provided in the Workshop area

.3 The hot water (glycol) heating system shall operate as the first stage of heating for the painting and drying operations and for general shop heating. For heating of the Workshops, the DDC system shall start the heating system whenever the average temperature in the shops is below setpoint. The circulation pump and heat pump shall be started. Water flow shall be confirmed operational before the heat pump compressors are allowed to operate.

.4 The heat pumps built in controls shall provide load control to stage the compressors with the DDC system re-setting the glycol (or "heating water") temperature upwards to achieve adequate heating and lowering it when the load drops.

.5 When heating when the paint room system is engaged for painting and/or drying, the heating system shall reset the Workshop room temperature setpoint to be 2 degrees C (adjustable) above the supply air setpoint for AHU-3 to assist with heating as required.

.6 The DDC system shall cycle the unit heater fans on to provide heating as required while the heating loop continues to circulate. To provide supplemental air movement, the unit heaters shall be capable of operating even when the glycol loop is not circulating (through DDC control).

.7 The glycol circulation pump and heat pump shall be stopped when heating is not required, after a suitable delay. a time limited, uh fan on over-ride shall be provided on the graphics screen.

1.7 New Split System Heat Pumps and existing Office Electric Baseboards

.1 The office area split system heat pumps are to be supplied with a hard wired, wall mounted, 7 day programmable, heating/cooling thermostat. Program each thermostat to provide continuous operation and a 21 degrees C heating setpoint and a 23.5 C cooling sepoint. During unoccupied hours the heating setoint shall be decreased by 5 C and no cooling shall be provided (adjustable).

.2 The heat pump systems shall come complete with built in control systems to maintain the temperature setpoint and automatically switch between heating and cooling mode. The heat pumps shall be set up to operate on a weekly schedule.

.3 The DDC system shall not control the new split system heat pumps but shall be used to enable/disable and monitor the office heat pumps.

.4 The DDC system shall use relays to control existing electric baseboard heaters in the office areas. Existing heaters are 240v/1/60 and shall be disabled when: the space temperature is above the global room setpoint or the current time is outside

of regular work hours. Provide the number of control zones as indicated on the accompanying drawings.

1.8 Graphic Screens

.5 Graphic screens displaying HVAC systems information shall be created for improved analysis and troubleshooting of system operation.

.6 Graphics shall display equipment operating parameters, adjustable setpoints and trend logs. Graphic screen shall have zone supply air temperature and setpoint, as well as paint room make-up air and exhaust system information.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The articles of this Section 26 00 10 shall apply to each Section enclosed.

.2 All work shall be completed to Owner's requirements and building standards in accordance with the relevant section, articles and details of the existing building specifications and drawings.

1.2 DEFINITIONS

.1 For the purposes of this specification, "Owner", "Department" and "Departmental Representative" shall refer to the Department of Fisheries and Oceans and "Consultant" shall refer to the Departmental representative.

.2 Where the words "indicated", "designated", "shown", "noted", "listed", or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to is "indicated", "designated", "shown", "listed" or "noted" in the Specifications or on the Drawings.

.3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by" or "inspected by" the Departmental Representative.

.4 The term "provide" where used, shall be understood to include labour, materials and services necessary to supply and install the item or work referred to.

1.3 GENERAL PRODUCT NOTATION

.1 Product manufacturer names, product nomenclature, model numbers, availability, options and features can and do change regularly. As a result, manufacturer and product nomenclature determined at time of design and as presented in these specifications may differ from most recent nomenclature.

.2 It is incumbent upon the Contractor and Suppliers to confirm all product nomenclature, options and features, in comparison to descriptions and performance criteria detailed within these specifications, with the manufacturer or sales agency prior to quoting on the project and prior to ordering of materials.

.3 No accommodation will be made for cost implications due to failure to provide information to and confirm product description and product nomenclature as shown in the tender and at time of ordering with the manufacturer or sales agency. This is an especially critical step to be taken when dealing with solid-state light emitting diode lighting product, automated local controls and low voltage controls systems.

1.4 CONTRACTOR / SUPPLIER RESPONSIBILITY

.1 Provide products listed in these specifications or Consultant accepted equivalents. See requirements in Article: Equivalency; below.

.2 No product substitutions or alternates are to be provided. No deviations from specified products are allowed without Consultant acceptance in writing.

1.5 EQUIVALENCY

.1 Manufacturer products listed in these specifications are provided as materials or equipment already reviewed and accepted for inclusion in the Work. These listed materials or equipment demonstrate the minimum quality and performance of materials and equipment that manufacturers offerings and requests for equivalency must demonstrate in order to be considered for inclusion in the project.

.2 Unless stated 'no equivalent', manufacturers, their agents or representatives may and are invited to submit materials or equipment for consideration as equivalent to listed materials or equipment by submitting written request to the Consultant and providing information for submittals as detailed within these specifications.

.3 All requests for equivalency must be submitted in writing no later than three (3) business days prior to the close of tender or request for pricing and shall include the following:

- Project Number;
- Date of submission;
- Name and contact information of entity requesting equivalency;
- Identification of what products equivalency is being requested for, including type identifier or product name;
- Nomenclature and supporting technical documentation (shop drawings, etcetera) for all products for which equivalency is being requested.

.4 Incomplete equivalency request submissions will not be reviewed.

1.6 EXAMINATION OF SITE CONDITIONS

.1 Carefully examine local conditions affecting the Work and building site, together with all other trades to make sure that Work under Specification and as shown on Drawings can be satisfactorily carried out without changes. Work of all trade Divisions shall be examined, before commencing Work, and any defect or interference affecting Work shall be reported at once.

.2 No allowance will be made for any expense incurred through failure to make these examinations or on account of any condition on site or item existing thereon which was visible or known to exist at time Tender for Work was submitted.

1.7 INITIAL SITE WORK UPON AWARD OF WORK

.1 Upon award of contract, perform a "general review" of the Work throughout the building(s). These efforts MUST be done before ordering of any materials.

.2 All site assessment conditions found that require changes to specified luminaires, controls or other components of the modification or new products shall be relayed to the Consultant and reflected in shop drawings and construction drawings. Ensure that changes to equipment nomenclature or descriptions are included in shop drawings before sending shop drawings to Consultant for review.

.3 For general project tasks for all project types, the review will not be limited to, but to

include the following:

.1 Confirm with Consultant scheduling of project, Departmental Representative's requirements, phasing of Work, hours when work can be conducted, storage location for materials, security and access procedures;

.2 Confirm voltage service for area of Work.

.4 Upon completion of this review, identify the areas and notify the Consultant of any discrepancies with tender documents. Failure to do this review will result in a reject for claims for any major changes to scope-of-work due to product items or voltage changes.

.5 Changes required as identified by this review must be submitted for accepted by the Owner or Departmental Representative prior to ordering of products or materials.

.6 Where no Add/Delete Pricing are requested as part of the tender bid pricing, provide a quote for all requested changes. Quotes will be reviewed by the Consultant, Owner and / or Departmental Representative and written acceptance will be provided authorizing the change prior to ordering of products or materials.

.7 Conduct an on-site orientation and procedure meeting for all personnel who will be working on-site prior to commencing the Work. During this orientation, workers are to be advised of sign-in procedures, location of staging areas, location of storage facilities, security requirements / procedures, locations of first aid stations and emergency contact numbers.

1.8 DETAIL DRAWINGS AND INSTRUCTIONS

.1 Submit notification of locations where installation of equipment would interfere with interior treatment and use of building. Detail drawings or instructions exactly locating these items will then be issued.

.2 On request of the Departmental Representative, the Contractor shall submit all his drawings respecting the work to the Departmental Representative for acceptance before using them, but the Contractor is responsible for performing the work properly notwithstanding such acceptance.

.3 The Contractor shall perform the work in accordance with drawings and instructions supplied by the Departmental Representative but shall not use such drawings for construction, manufacture or installation unless the Departmental Representative has released them for such use.

.4 The Contractor shall inform the Departmental Representative of any instructions given by any parties that would affect the equipment, quantities, locations, price, or any modification to the work as outlined in this Contract. Failure to comply may result in the rejection of the work or any associated costs.

1.9 WARRANTY AND CORRECTION AFTER COMPLETION.

.1 Submit a written warranty to Owner for one year from date of final acceptance for any part of Work accepted by the Consultant. Should any defects, failure or unacceptable workmanship become apparent during the warranty period, the work shall be replaced or repaired at no cost to the Owner.

1.10 CERTIFICATES AND PAYMENTS

.1 Arrange and pay for permits, tests and certificates of inspection for the Work. Do Work in compliance with all laws, rules, ordinances and regulations having jurisdiction.

.2 Inspection certificates, as follows, shall be submitted before final acceptance will be issued:

.1 Electrical Inspection

.2 Seismic Engineer Certification

1.11 PROTECTION OF WORK AND PROPERTY

.1 Each trade shall protect the Owner's property, its own and other trade's finished and unfinished work from damage, due to the carrying out of its work. Cover Owner's Property, floors and other work with tarpaulins, if required, for this purpose. Each trade shall assume responsibility for repairing damage to Owner's Property, floor and wall surfaces resulting from its failure to provide such protection. Carry out such repairs in a satisfactory manner without expense to Owner.

1.12 CLEANING UP

.1 Assume responsibility for removing tools and waste materials throughout duration of Work and upon completion of Work. Thoroughly clean and vacuum area of Work after each work shift and/or as directed by Departmental Representatives.

.2 Totally cleanup and restore the work area to ensure that no disruption to the work area takes place. The area MUST be left in the same or better condition than before the work commenced.

.3 The room must be left in the locked or unlocked position as originally found.

1.13 CO-ORDINATION

.1 Work of this trade shall be laid out so that it does not conflict with Work under other Division of Specification for this project. Make good damage to Owner's property or other trade's work, caused by improper location or carrying out of Work.

1.14 WORK IN EXISTING BUILDING

.1 Work includes adding new breakers to the existing Distribution Board(s) and the installation of electrical wiring from the distribution panel to the new HVAC equipment. This may include changes of old and new construction to suit as shown or as specified herein.

.2 Ensure adequate access through the existing building for the new equipment and make allowance in tender price for any required building changes.

.3 Obtain approval from Departmental Representative prior to penetrating any structural surfaces including floor slabs. Obtain from Departmental Representative approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.4 Remove or modify existing devices and equipment as necessary to suit new Work. Undertake Work in an approved manner so that finished Work presents a neat and clean, as new appearance.

.5 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Departmental Representative.

.6 After completion of work arrange and pay for the repair of any damaged or dislodged fireproofing material.

.7 All new circuit breaker equipment shall be installed in the existing Distribution Panel with access for inspection and maintenance. Access panels may be provided with the approval of the Departmental Representative.

.8 All Contractors shall exercise due care and diligence when working in the Building. Existing finishes and floor covering must be protected when the work is taking place. Clean-up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.9 All work on site shall be co-ordinated with the Departmental Representative as to minimize disruptions. Installation of equipment on tenant floors or public areas must take place outside of the Occupants regular business hours. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Departmental Representative.

.10 Contractor must not use tenant or office floor facilities to clean equipment and must leave the facilities in appropriate condition for public use.

.11 Prior to any welding, Contractor must obtain Owner's approval to ensure that the smoke detection system is turned off prior to work.

1.15 LOCKOUT / TAG OUT OF WORK

.1 No Work shall be conducted on live circuits or energized equipment above the CEC defined extra-low voltage threshold.

.2 All Work above this threshold shall be conducted under 'Lockout / Tag Out' (LTO) requirements contained with of the CEC and WorkSafe BC guidelines before conducting Work. At worksites where Occupational Health and Safety (OHS) guidelines apply, requirements of these guidelines must also be taken into account for LTO.

.3 LTO recommendations detailed in this section are to be followed in conjunction with regulatory requirements. In the event of conflict between the recommendations here written and regulatory requirements of CEC, WorkSafe BC, OHS or any other jurisdiction having authority, the regulatory requirements take precedence.

.4 For adequate LTO, overcurrent device must be physically place into / switched to the off position and feeder must be de-energized prior to beginning Work.

.5 Immediately upon physically placing / switching the overcurrent device into the 'off' position, apply approved lockout / tag out device on the overcurrent device, in such a manner that the overcurrent device cannot be energized without removal of the lockout tag device. Once lockout device is applied, worker(s) are to affix to the lockout device a keyed lock that precludes removal of the lockout device and allowing for activation of the overcurrent device and energizing of the feeder without first removing the keyed lock.

.6 All workers conducting Work on equipment connected to a circuit or service feeder where the overcurrent device is being placed into / switched to the off position for de-energization and having a lockout / tag out device applied shall affix their own lock to the lockout / tag out device. This requirement is regardless of the number of workers conducting Work on a circuit or service feeder, all workers are to apply locks.

.7 All workers are to apply, lock, unlock and remove their own lock to the lockout / tag out device for any overcurrent device, circuit or feeder on which they will be personally conducting work.

.8 NO WORKER SHALL APPLY, LOCK, UNLOCK OR REMOVE THE LOCK OF ANOTHER WORKER. There are no exceptions to this requirement; any workers found contravening this requirement will be removed from the project for unsafe conduct and not be allowed to return to Work on the project.

.9 Apprentices may not turn / switch off overcurrent devices, apply lockout / tag out devices and affix locks without the supervising licensed journeyman electrician for the Work being present at the overcurrent device location with the apprentice and where the journeyman has physically checked the lockout / tag out device for being properly and securely installed. Once the lockout / tag out device has been confirmed to be properly installed by the journeyman, and any apprentices conducting Work on the de-energized circuit have affixed their locks to the lockout / tag out device, the supervising licensed journeyman electrician for the Work shall apply his lock to the device.

.10 Prior to conducting any Work on feeders or equipment on a circuit or switched off overcurrent device, allow for sufficient de-energization time for all components of equipment to complete discharge. This is especially important on all circuits, feeders or equipment containing or serving capacitive components or capacitor devices.

.11 The last person to remove their lock from any lockout / tag out device is to be the supervising licensed journeyman electrician for the Work. The journeyman shall physically verify that all other workers are accounted for and are not still engaged with the circuit or feeder or equipment that is subject of the Work and connected to the de-energized and locked out overcurrent device, that they all are physically in possession of their own locks, that the Work is properly completed and safe for activation of the overcurrent device and re-energization of the circuit.

.12 Once all checks and verifications of conditions being safe to do so have been conducted, the journeyman may activate the overcurrent device and re-energize the circuit or feeder or equipment.

.13 The supervising licensed journeyman electrician for the Work shall log full information of the locked out overcurrent device, circuit, feeder or equipment. They are to record the overcurrent device location, any applicable central distribution panelboard or panelboard or sub-panelboard, the circuit number, date and time of de-activation of overcurrent device, date and time of reactivation of overcurrent device, list all workers conducting Work on the subject service, condition overcurrent device last left in, and attest that all workers are accounted for, that locks and lockout / tag out devices have been removed (if overcurrent device has been re-energized).

1.16 SCHEDULE OF WORK

.1 The on-site work associated with this project must be done to suit the Owner's schedule. Refer to Sections 01 11 00 Summary of Work and 01 14 00 Work Restrictions.

.2 Contractor shall provide a general work schedule at the commencement of the Work on the existing Distribution Board and weekly updates detailing what Work will occur and what areas will be affected during the next week. Areas of restricted access will need to be scheduled to suit Owner and not scheduled with other Work.

.3 All work shall be co-ordinated with the Departmental Representative and/or the Consultant as to minimize disruptions to the occupants.

.4 Work on the existing Distribution Board must be scheduled with the Departmental Representative at least one week ahead of planned work. A detailed schedule shall be provided when requested. Each schedule must be approved by the Departmental Representative. Contractor must allow changes or limited access to occur. It may be necessary to adjust schedule or areas planned to suit occupant specific schedules or security requirements. Contractor must co-operate and adjust schedule to suit.

.5 All Contractors shall exercise due care and diligence in working in the occupied areas. Equipment must be covered when the work is taking place. Clean-up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

1.17 EQUIPMENT PROTECTION AND STORAGE ON SITE

.1 Storage space for contractor's materials or tools is minimal within the buildings. Contractor shall submit request for areas of preference.

.2 Storage location will be at a location as designated by the Departmental Representative.

.3 Upon completion of each shift, the Contractor must remove all unused materials and tools from the work area and store in designated areas only.

.4 Store electrical material and equipment such as switchgear in a dry, clean location and cover with polyethylene plastic to preserve factory finish.

.5 Protect exposed or freestanding equipment with plastic sheets to minimize entry of dust and dirt and marring of finished surfaces during progress of Work.

1.18 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods during the replacement of the Distribution Board, Circuit Breakers and Transformers.

.2 Obtain permission of the Owner before shutting down or disconnecting electrical and fire protection services. Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time. Include in Tender Price for overtime that may be required to tie-in services at night or on weekends.

.3 The contractor shall inspect the existing Distribution Board structure, take measurements and photographs in preparation of the modifications to the existing Distribution Board(s).

.4 The contractor shall submit prior to commencement of work on site full details of how he intends to facilitate the installation of the new circuit breakers.

.5 The Owner reserves the right to complete and/or repair any work that is not in operating condition beyond scheduled shutdowns, in order to maintain the Owner's operation. Any costs incurred with this work will be charged to the Contractor.

1.19 DRAWINGS

.1 Drawings as provided do not show every architectural or structural detail and are diagrammatic only. Take any information requiring accurate measurements from the building and not the drawings.

.2 Drawings as provided, showing the Work, have been prepared from information provided after completion of previous construction. These drawings have been provided as an aid to the Contractor, the Owner, and the Consultant. Drawings do not guarantee the accuracy of the existing or "as-built" conditions. The Contractor shall verify all conditions affecting the work of this contract.

.3 Equipment dimensions are based on the first or top named manufacturers indicated on the Equipment List. Dimensions of items by other listed manufacturers shall not exceed available space with necessary allowance for service and maintenance.

.4 Make necessary change to existing busways to accommodate structural conditions, where location of new raceways and equipment must be altered to suit job conditions. Obtain approval from Departmental Representative and note changes on Record Drawings.

1.20 RECORD DRAWINGS

.1 Refer to Section 01 78 00 Closeout Submittals.

.2 Provide one full size copy of the up-dated single line diagram shall be mounted under clear Perspex or Tampered Glass on the wall in the Electrical Room.

1.21 DATA BOOK / MAINTENANCE MANUALS

.1 Refer to Section 01 78 00 Closeout Submittals.

1.22 STARTING UP AND TRAINING

.1 Provide services of a skilled electrician as required to start up the system in its proper sequence, and to thoroughly explain the operation and maintenance of each system provided to the full satisfaction of Owner if so required. In addition, provide specialized instructions by the respective manufacturers as described under the appropriate clauses of this Specification. Arrange with the Owner's the most suitable time for instructions to their operating and maintenance personnel. Keep a record of dates and duration of each instruction period together with the names of persons to whom the instructions were given together with their position title and contact information. Submit one signed copy of such record included in the Data Book.

.2 Where Owner wishes to take over certain areas ahead of project completion date and these areas are intended to be fed from the new distribution systems, make temporary connections to such areas using services existing in these areas. Re-connect these areas to the permanent services, as shown, at a later date when new distribution systems are available in the areas concerned.

1.23 TEMPORARY FIRE PROTECTION

.1 Provide and maintain temporary fire protection and fire extinguishers wherever welding, soldering or other open flame equipment is used. Provisions for temporary fire protection shall be co-ordinated with Contractor and with the Owner.

1.24 TEMPORARY LIGHTING AND POWER SERVICES

.1 Provide temporary general lighting throughout construction site utilizing existing luminaires, alternatively provide lighting strings with 150W, I.F. lamps at 10 foot centres.

.2 Lighting levels shall conform to WCB Construction Safety Standards and all authorities having jurisdiction.

.3 Relocate temporary lighting throughout construction site as often as necessary, such that temporary lighting is provided in all areas where work is being performed.

.4 Provide additional task lighting for specific working conditions where higher lighting levels are required.

.5 Provide temporary power supplies with receptacles and extension cords from existing building services, for construction equipment, e.g.: drills, saws, etcetera. Locate, relocate and remove services as necessary.

.6 Maintain the temporary facilities in good repair and safe working condition throughout the duration of the construction project.

.7 Remove, at the end of project, the above noted temporary systems.

1.25 WORK WITH ASBESTOS FIREPROOFING

.1 Upon award of the tender, and prior to the commencement of any work, the Contractor shall investigate the spaces where any major electrical work is to be performed to determine the existence of any identifiable or suspected asbestos based firebreak or insulation materials that may constitute a potential hazard to workers within the work area or occupant of the space in or near the work area.

.2 Should the Contractor observe any identifiable or suspected asbestos based products in use in the spaces the Contractor needs to work, he shall immediately cease work, and notify the Owner, and the Departmental Representative.

.3 Upon notification, Owner will provide verification of the existence of any asbestos materials in the areas of work.

1.26 FINAL SITE REVIEW

.1 Refer to Section 01 77 00 Closeout Procedures.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 45 00 – Quality Control.

.3 Section 01 35 29.06 – Health and Safety Requirements.

.4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 Institute of Electrical and Electronics Engineers (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, most recent edition.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 REGULATORY REQUIREMENTS

.1 Execution of all Work shall be performed to comply with and conform to the following requirements:

- 2018 Canadian Electrical Code C22.1-12 (or current version);
- 2018 BC Building Code (or current version);
- 2015 National Building Code (or current version);
- 2015 National Fire Code (or current version).

Work shall be performed to meet the above mentioned codes and, where applicable, to the satisfaction of all applicable provincial, city, municipal and / or district bylaws and authorities having jurisdiction of the place of Work.

.2 Where requirements detailed in these specifications exceed code requirements or are more stringent than code requirements, the specification requirements shall take precedence and shall be adhered to.

.3 In the event of a conflict between code requirements and those detailed in these specifications, the former shall prevail. Note that requirements within the specification that are more stringent requirements than codes do not constitute a conflict.

.4 The Contractor shall ensure that all seismic restraint requirements, as directed by building or electrical codes for the city, municipality or district where each facility is located, for new or relocated luminaires are met and adhered to.

1.5 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.

1.6 SUBMITTALS

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

.2 Shop drawings:

.1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 If changes are required, notify Owner's Representative of these changes before they are made.

.3 Quality Control: in accordance with Section 01 45 00 – Quality Control.

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction, inspection authorities for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.7 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 – Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold a valid Master Electrical Contractor license or are employed by such an entity.

Apprentices may conduct Work under the supervision of a journeyman electrician in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.2 Where the Contractor arranges for product to be delivered to site by third party carrier, the Contractor is to arrange for Contractor staff to meet the carrier, unload all materials and products, move immediately to storage and sign for all deliveries.

.3 Owner, Owner's Representative or Consultant will not sign for or accept delivery of any materials for the project, with the exception of spare materials for maintenance being supplied to the Owner as part of the contract.

.4 Contractor is not to use Owner's staff, equipment or shipping / receiving areas for delivery of materials and products; unless prior agreement and arrangement has been made with the Owner or Owner's Representative.

1.9 SYSTEM STARTUP

.1 Instruct Owner's Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 STANDARD OF MATERIALS

.1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

.2 Materials required for performance of work to be new and the best of their respective kinds and of uniform pattern throughout work.

.3 Equipment items are to be standard products of approved manufacture. Identical units of equipment are to be of same manufacture. In any unit of equipment, identical component parts to be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.

.4 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, to be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

.5 Materials to bear approval labels as required by Code and / or Local Inspection Authorities and be eligible for sale and installation in Canada. All equipment to be approved by a certification agency listed in BC Electrical Bulletin 0-7-0. Where it is stated within this specification that equipment "must be CSA approved", or similar wording, it is to be taken that equipment bearing an appropriate certification label from any certification organizations listed in federal, provincial or territorial bulletins is acceptable.

.6 Install materials in strict accordance with manufacturer's recommendations.

.7 Include items of material and equipment not specifically noted on drawings, provided on informational bills of material, or mentioned in specifications but which are necessary to make a complete and operating installation.

.8 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Section, before such items are purchased.

.9 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

.10 Where requirements of this Specification exceed those of applicable standards, this Specification governs.

2.2 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction.

.2 Decal signs, minimum size 175 x 250 mm.

2.3 BARRIERS AND WARNING AIDS

.1 Barriers and warning aids shall be used to protect those who access or traverse near the space or areas of Work in both interior and exterior areas where the Work could pose a hazard to the passersby. The intent is to cordon off hazard areas and warn of a hazard.

.2 Where required for safety and security of the construction zones and to avoid potential hazards to occupants and users of the space or site, areas of Work that are accessible to the public or unauthorized occupants entering a Work location are to be barriered from public or occupant access with Departmental approved barriers and / or fencing.

.3 In locked rooms only accessible by authorized personnel or users, barriers and warning aids are required around Work if there is a potential for tripping hazard, accidental contact with temporary structures, access to scaffolding or lifts, open electrical that could allow for contact with live electrical conductors, buss bars or other components, or open mechanical equipment with rotary component or operable devices, anywhere there is potential for access and contact by occupants not associated with the Work and could present a danger for the unaware.

.4 Where available, follow and adhere to Owner or Owner's Representative site construction guidelines for public safety and barriers in construction areas. Request such documentation from the Owner or Owner's Representative.

.5 In the absence of such documentation, adhere to WorkSafe BC (WCB) guidelines for such safety equipment and procedures.

.6 Minimally, the Contractor shall provide protection and warning as detailed in the following articles:

.7 During times of construction when contractor personnel are actively working on site and in an area, high visibility cones, barriers and tape shall be utilized to surround areas of Work as warning to staff, the general public and any other occupants / users of the facility, grounds and site that there is construction underway.

.8 Contractor personnel shall actively guard against unauthorized persons entering the areas of work during active construction.

.9 During times where no construction is happening, for example at the end of the work shift, any exposed Work or equipment shall be barriered off with fencing, high visibility tape and, where applicable, safety cones. These barriers must be structured or affixed such that they cannot easily be removed without use of tools, and wherever possible must be locked in position.

.10 Security or facilities staff must have copies of keys for any locks used for barriers and fences. Keys shall be colour coded or otherwise have indicators as to which key works which lock; for quick and easy access to the barriered area.

Barriers, safety cones, and fencing shall NOT impinge or restrict walkways, doorways, or any other commonly used routes of building access or egress. Do not block or restrict use of entire walkways or passageways

2.4 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

.2 Apply anti-oxidization compounds as required for connections made between dissimilar metals.

2.5 EQUIPMENT IDENTIFICATION

.1 Labels for feeder conduits, cables and bus ducts to indicate their content are to comprise pressure sensitive tape. Print labels on plastic coated tape, 50.8 mm x 152.4 mm (2" x 6") size with black printing on yellow background indicating applicable voltage, i.e. 600 volts.

.2 Provide name plates on each piece of electrical equipment, namely power panels, distribution panels, lighting panels, transformers, disconnect switches, contactors, telephone panels, miscellaneous systems panels, double throw switches and automatic transfer switches.

.3 Indicate panel designation, mains voltage and panel and circuit number from which this panel is fed on nameplates for each electrical panel.

.4 Indicate transformer primary and secondary voltage and transformer name and designation on nameplates for transformers.

.5 Indicate equipment being controlled and voltage on nameplates for disconnects and contractors.

.6 Indicate system, and voltage and load of area served on nameplates for terminal cabinets.

.7 Nameplates are to be black-white-black lamicoid with bevelled edges and white engraved letters. Fasten or cement nameplates to equipment in a conspicuous location. Locate nameplate on flush mounted panels on front of panel behind hinged door.

.8 Label feeder conduits, cables.

.9 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.

.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor).

.3 At every access point on concealed conduit duct or cable.

.10 Labels are to be visible from 5'-0" (1524 mm) above adjacent floor or platform.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Fire Alarm	Red	

2.8 SLEEVES AND CURBS

.1 Maintain the integrity of the fire rating of the floors and walls around electrical raceways and/or cables passing through such floors and/or walls.

.2 Materials used to maintain rating to have a minimum 2 hour ULC listed rating.

.3 Install fire stop or sealant material between opening or sleeve and raceway or cable in accordance with the recommendations of the manufacture to achieve a minimum 2 hour rating, unless otherwise noted.

2.9 SAFETY SWITCHES

.1 Fused or unfused disconnect or safety switches to be Type “A”, quick-make, quick-break construction with provision for padlocking switches in either “ON” or “OFF” position.

.2 Fused switches to have fuse clips designed for NEMA Class “J” HRC fuses and designed to reject standard N.E.C. fuses.

.3 Switches throughout job are to be of same manufacture and to match base building standards.

.4 Provide fused or unfused safety or disconnect switches as shown and as required.

2.10 FUSES

.1 Fuses to conform to CSA Standard C22.2 No. 106-1953 or CSA Standard C22.2 No. 106-M1985.

.2 Fuse interrupting rating to be 200,000 A RMS symmetrical.

.3 Fuses are to be sized as shown.

.4 Provide a complete set of fuses in each fusible device supplied under this Division.

.5 Provide a spare set of three fuses of each size and type supplied and hand over to Owner at completion of work.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: plastic/sheet metal, sized for free passage of conduit, and protruding 50mm from poured surface.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150m horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

.2 Under no circumstances is a switch to be located behind a door or out of sight and easy reach of a person entering a room or space.

3.5 TEMPORARY LIGHTING AND POWER SERVICES

.1 Provide temporary general lighting throughout construction site; existing luminaires may be utilized for this task, where possible. In areas where lighting has been removed to suit construction, provide lighting strings with incandescent, compact fluorescent, or solid-state light emitting diode lamps, to approximate the equivalent lumen output equivalent of incandescent 150W I.F. lamps mounted on 10 foot centres, or through use of high powered portable work lights. Lamp placement on lighting strings is variable depending upon light source and lumen output of lamps utilized to meet equivalency and minimum footcandle illumination levels as detailed in this section.

.2 Lighting levels in work areas shall conform to WorkSafe BC's (WCB) Occupational Health and Safety Regulations. For work sites not under WorkSafe BC jurisdiction, obtain and adhere to regulations of the jurisdiction having authority for the site type and location.

.3 Where no defined illumination levels are detailed in regulations, provide a minimum 50 footcandles of illumination across the work area.

.4 Relocate temporary lighting throughout construction site as often as necessary, such that temporary lighting is provided in all areas where work is being performed.

.5 Provide additional task lighting for specific working conditions where higher lighting levels are required.

.6 Provide temporary power supplies with receptacles and extension cords from existing building services, for construction equipment, e.g.: drills, saws, etc. Locate, relocate and remove services as necessary.

.7 Maintain the temporary facilities in good repair and in safe working condition throughout the duration of the construction project.

.8 Remove, at the end of project, the above noted temporary systems.

3.6 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.

.2 Conduct following tests in accordance with Section 01 45 00 – Quality Control.

.1 Circuits originating from branch distribution panels.

.2 Motors, heaters and associated control equipment including sequenced operation of systems.

.3 Fire alarm system.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18.2-06, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65-13, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1979 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal all packaging material for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility as approved by appropriate government agency as a waste disposal and recycling facility.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Luminaire type splicing connectors to CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- .1 Connector body and stud clamp for stranded or round copper conductors.
- .2 Clamp for stranded or round copper.
- .3 Not used.
- .4 Stud clamp bolts.
- .5 Bolts for copper conductors.
- .6 Not used.
- .7 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable as required to: CAN/CSA-C22.2 No.18.2.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

- .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
- .2 Install mechanical pressure type connectors and tighten screws, with appropriate compression tool where recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .3 Install fixture type connectors and tighten. Replace insulating cap.
- .4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.3 Section 26 05 00 – Common Work Results for Electrical.

1.2 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 CSA C22.2 No. 0.3-09 Test Methods for Electrical Wires and Cables.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse and recycle in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, RWU90 XLPE, Jacketted/Non Jacketted.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWU/ TWH /T90 Nylon rated at 600 V.

.4 Neutral supported cable: 3 phase insulated conductors of Copper and one neutral conductor of Copper steel reinforced, size as indicated. Type: NS75 /NS90 Insulation: Type NS-1 rated 300 V /Type NSF-2 flame retardant rated 600 V.

2.2 CONDUCTORS, WIRES AND CABLES

.1 All conductors are to be copper conductors. All AWG sizes given in this specification refer to the copper AWG size.

.2 Wiring installed in conduit, unless otherwise noted, to be 600 volt RW-90 X-Link. /

.3 Use copper wiring, minimum No. 12 gauge for lighting and power wiring. Size wires for 2% maximum voltage drop to farthest outlet on a loaded circuit.

.4 Home runs to 120 volt lighting and receptacle panels, which exceed 75 feet (23 m) in length, to be minimum No. 10 gauge. Home runs which exceed 38mm (125’-0”) in length to be minimum No. 8 gauge.

2.3 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Conductors:

.1 Grounding conductor: copper as indicated.

.2 Circuit conductors: copper as indicated, size as indicated.

.3 Insulation:

.1 Ethylene propylene rubber EP .

.2 Cross-linked polyethylene XLPE .

.3 Rating: , 600/1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: flat/ interlocking/galvanized steel/ aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.7 Fastenings:

.1 One hole malleable iron /steel /aluminum /zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1200mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

.1 Watertight, explosion-proof approved for TECK cable.

2.4 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90/ ACL90 - lead sheath over cable assembly and under armour.

.3 Armour: interlocking type fabricated from galvanized steel strip.

.4 Type: ACWU90 /PVC/flame retardant jacket over armour and compliant to applicable Building Code classification for this project.

.5 Connectors: anti short connectors.

2.5 CONTROL CABLES

.1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:

.1 Insulation: thermoplastic.

.2 Sheath : cotton braid/ thermoplastic jacket/and armour of closely wound aluminum wire.

.2 Type: low energy 300 V control cable: solid/stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:

.1 Insulation: PVC /TW/ TW 40 degrees C /TWH/ polyethylene.

.2 Shielding: tape coated with paramagnetic material /tape coated with diamagnetic material /wire/ braid/ metallized tapes over conductors.

.3 Overall covering: PVC jackets /polyethylene jackets/ lead sheath/aluminum sheath /interlocked armour of flat galvanized steel /aluminum strip/ copper strip.

.3 Type: 600 V stranded annealed copper /semi-annealed aluminum/ ACM alloy conductors, sizes as indicated:

.1 Insulation: PVC/ TW /TWH/ TW 40 degrees C, butyl rubber insulation type/ RW75 /R90, polyethylene /cross-linked polyethylene type/ RW75 (x-link)/ R90 (x-link)/ RW90 (x-link)/ ethylene-propylene rubber insulation type/ RW75 (EP)/ R90 (EP)/ RW90 (EP).

.2 Shielding: magnetic tape /wire/braid/metallized tapes/over/each conductor/each pair of conductors/conductors.

.3 Overall covering: thermoplastic jacket/thermosetting jackets/with sheath of/aluminum/lead/interlocked armour/and jacket over sheath of/PVC/thermosetting compound.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 WIRING METHODS

.1 Install wiring in conduit unless otherwise specified.

.2 Use thin wall conduit for branch circuit and signal wiring in ceilings, and furred spaces. Use rigid galvanized steel conduit for wiring in poured concrete, or where conduit could be exposed to mechanical injury.

.3 Enclose all visible surface conduits in public areas in surface raceway.

.4 Type AC-90 armoured cable may be used for local lighting luminaire connections, but only in removable suspended ceilings and down drops in hollow walls and partitions. Obtain Departmental Representative's written authorization prior to using either flexible conduit or armoured cable in any other location.

.5 Maximum length of AC-90 to be run in ceiling space / plenum is 6,096 mm (20'- 0"). All AC-90 cable and conduit are to be supported as high as possible above ceiling to allow removal of all ceiling tiles, luminaries, etc. Cables are not permitted to rest on false ceiling. All home runs must be in conduit.

.6 Conduit is to be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced. Do not bend conduit over sharp objects. Improperly formed bends and running threads will not be accepted. Do not use bends and fittings together.

.7 Run conduits and cables in finished areas concealed, above finished ceilings, under floors, in walls and in partitions. Run conduit and cables in unfinished areas, such as fan rooms and penthouses, exposed and install at right angles or parallel to building lines, accurate in line and level.

.8 Runs of conduit and cables, where shown are indicated only by general location and routing. Install conduits and cables to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. Install as close to building structure as possible, so that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

.9 Wiring and conduit for wall devices etc., to be routed in ceiling space of floor they are serving.

.10 Install conduit and cables to avoid proximity to water and heating pipes. They are not be run within 152.4 mm (6") of such pipes except where crossings are unavoidable, in which case they are to be kept at least 25 mm (1") from covering of pipe crossed.

3.3 GROUNDING

.1 Ground electrical equipment and wiring in accordance with Canadian Electrical Code and Local Inspection Authority's Rules and Regulations.

.2 Condition or existence of grounding of existing luminaries must be reviewed and proper grounding confirmed. Inform Consultant if ungrounded luminaries or service feeder to luminaires are identified.

3.4 CIRCUITING REQUIREMENTS

.1 Circuitry as indicated is diagrammatic only.

3.5 CONDUCTORS, WIRES AND CABLES

.1 Colour code all conductors. Conductors No. 2 gauge and smaller to have colour impregnated into insulation at time of manufacture. Conductors size larger than No. 2 gauge may be colour coded with adhesive colour coding tape but only black insulated conductors are to be employed in this case, except for neutrals which are to be white whenever possible. Conductors of No. 8 gauge and larger must be stranded.

.2 Colour code as follows:

Phase "A"	Red	Ground	Green
Phase "B"	Black	Neutral	White
Phase "C"	Blue	Control	Orange

.3 Neutral conductors may be identified by a coloured insulation with three or more extruded longitudinal white stripes along the insulation, and will be deemed to have a white or natural covering. All neutral conductors used in the Work must match building standard.

.4 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.5 Splice wire, up to and including No. 6 gauge, with twist-on style connections rated minimum 600 volts. Connection body to be moulded of thermoplastic. Spring insert to have an expandable square-edge. Splice large conductors using split-bolt or compression type connections wrapped with PVC tape.

.6 Where colour coding tape is utilized, it is to be applied for a minimum of 50.8 mm (2") at terminations, junction and pull boxes and condulet fittings. Do not paint conductors under any circumstances. Colour coding also applies to bussing in panels.

3.6 EQUIPMENT AND WIRING TESTING

.1 Make tests of equipment and wiring at time requested.

.2 Tests are to include measured insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

.3 Supply meters, materials and personnel as required, to carry out these tests.

.4 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

.5 Connect single phase loads so that there is the least possible unbalance of the supply phases.

.6 Where specialized equipment or controls systems requiring commissioning are installed as part of Work, arrange and pay for services of manufacturer's factory service engineer / technician to supervise initial start-up or calibration of such equipment or controls. Engineer / technician shall check systems installation and verify operation is correct or shall adjust, balance and calibrate components, or direct installer to perform these tasks, including installation related wiring and operation of controls, to the satisfaction of the engineer / technician and the Consultant.

.7 Instruct Owner's operating personnel in the operation of the installations. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of installation in complete working order, and to ensure that Owner's operating personnel are fully conversant with every aspect of the operation, care and maintenance thereof.

3.7 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.

.3 Conductor length for parallel feeders to be identical.

.4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.8 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.9 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable concealed, securely supported by staples/straps or hangers.

3.10 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

3.11 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit/under floor raceways/cable troughs/underground ducts/by direct burial.

.2 Ground control cable shield.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 45 00 - Quality Control

.3 Section 01 74 21 -Construction/Demolition Waste Management and Disposal

.4 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.2 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding, or most recent edition.

.3 Canadian Electrical Code CSA C22.1-18, Sections 10, 26 and 36.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals:

.1 Provide in accordance with Section 01 45 00 - Quality Control.

.4 Manufacturer's Instructions:

.1 Provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 -Construction/Demolition Waste Management and Disposal.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Rod electrodes:

.1 Copper clad steel, 19 mm diameter by 3 m long or to meet code requirements.

.2 Conductors:

.1 Bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Conductors:

.1 PVC insulated colored green, stranded tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

.4 Conductors:

.1 PVC insulated colored green, stranded tinned soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

.5 Bolted removable test links.

.6 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.
.7 Wire connectors and terminations: as indicated.
.8 Grounding resistance bank:
.9 Outdoor, 3 phase, 300 A, rating, 13.2 kV, metallic type
.10 Cable sheath isolating sleeves.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.

.2 Ground fences in compliance with CEC Rules 26-300 to 26-324 and connect to grounding system independent of station ground.

.3 Install connectors and cadweld in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors during and after construction.

.5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process or permanent mechanical connectors to ANSI/IEEE 837.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG bare copper cable for taps on risers from main ground bus to equipment.

.8 Use tinned copper conductors for aluminum structures.

.9 Do not use bare copper conductors near un-jacketed lead sheath cables.

.10 Install grounding resistor bank.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.

.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

.3 Connect metallic piping water, oil, air, etc. inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.3 NEUTRAL GROUNDING

.1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

.2 Interconnect electrodes and neutrals at each grounding installation.

.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

.4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

3.4 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.

.3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and Consultant and local authority having jurisdiction.

.4 Perform test before energizing electrical system.

.5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate, both sealed and signed by a Professional Engineer licensed in British Columbia, before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 61 00 - Common Product Requirements

.2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.3 Section 26 05 00 – Common Work Results – Electrical.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

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

Part 2 Products

2.1 HANGERS

.1 Ensure that hangers used for electrical conduit are galvanized after fabrication.

.2 Do not use perforated strapping (grabbler bars) to hang conduit.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to poured concrete with expandable inserts.

.2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.3 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 1200 mm on-centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 – Common Product Requirements.

.3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 00 – Common Work Results – Electrical.

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 OUTLET BOXES

.1 Conform to CSA Standard C22.2 No. 18.

.2 Ceiling boxes are to be 101.6 mm (4") octagon or square, complete with fittings, where required to support luminaires.

.3 Switch and receptacles boxes to be:

.1 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.

.2 Boxes for 347 volt switches are to be similar but sized as per Code with barriers between switches.

.4 Where boxes are surface mounted in unfinished areas, they are to be FS condulets.

.5 Standard outlet boxes are to be manufactured from code gauge galvanized steel.

.6 Ensure outlet boxes installed outside building and/or in damp locations are FS weatherproof type. If in direct contact with the ground, they are to be made of cast iron.

.7 Provide a suitable outlet box for each luminaire, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

2.2 CONDUIT BOXES

.1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support outlet boxes independently of conduit and cable.

.2 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.3 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.

.4 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

.5 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, and fit with suitable flush trims and doors or covers, unless specifically noted otherwise.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 1-04(R2009), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada, or most recent edition.

.2 CSA C22.2 No. 45-M1981(R2007), Rigid Metal Conduit, or most recent edition.

.3 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, or most recent edition.

.4 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing, or most recent edition.

1.3 SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.3 Flexible metal conduit: to CSA C22.2 No. 56, steel.

2.2 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for NPS 1 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Use rigid galvanized steel threaded conduit except where specified otherwise.

.3 Use electrical metallic tubing (EMT) except in cast concrete or susceptible to mechanical injury.

.4 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.5 Mechanically bend steel conduit over 19 mm diameter.

.6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.7 Install fish cord in empty conduits.

.8 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.9 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Wherever possible, group conduits on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

General

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).

.2 CSA C9-02(R2007) , Dry-Type Transformers, or most recent addition.

.3 CAN/CSA-C802.2-[06] , Minimum Efficiency Values for Dry Type Transformers or most recent addition.

.2 National Electrical Manufacturers Association (NEMA)

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 dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00- Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

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

.2 Store and protect dry type transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN DESCRIPTION

.1 Design

.1 Type: ANN.

.2 3 phase,

.3 Voltage taps: standard.

.4 Insulation: Class 220

.5 Basic Impulse Level (BIL): 10kV

.6 Average sound level: standard

.7 Impedance: 6.9%

.8 Enclosure: NEMA 1

.9 Mounting: floor

.10 Finish: in accordance with Section 26 05 00- Common Work Results for Electrical.

.11 Copper windings.

.12 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.

.2 Label size: 7.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative

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

3.2 INSTALLATION

.1 Mount dry type 75 kVA transformer on floor.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 SEISMIC SUPPORT

.1 The installation of all major electrical equipment not limited to but including; transformers, distribution and power panels, new luminaires or the relocation of existing electrical equipment or luminaires must be installed in accordance with project related seismic and building code requirements. In addition, the installation must be done in accordance with ECABC Seismic Restraint Standards Manual – Guidelines for Electrical Systems.

.2 The seismic support installation must be clean, without any loose tails, so that the seismic supports do not interfere with maintenance or safety when working in the ceiling space or rooms with seismically restrained equipment.

.3 Include in the tender to retain a seismic specialist licensed as a professional engineer in BC. The seismic engineer shall submit prior to commencement of equipment installation a letter of assurance indicating responsibility for design and field review of seismic restraints related to the installation of relevant electrical equipment. At completion of installation, seismic engineer shall submit a letter of total acceptance without any deficiencies and appropriate schedules.

3.4 CLEANING

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

.1 Leave Work area clean at end of each day.

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

.3 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 dry type transformers installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards, or most recent edition.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal 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.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 Panels for 120/208 volt, 3 phase, 4 wire system to be complete with full size breakers with a symmetrical interrupting capacity of 22,000 A.

.3 Panels for 347/600 volt, 3 phase, 4 wire system, to be complete with breakers having a symmetrical interrupting capacity of 25,000 A.

.4 Panels to be factory assembled of the same manufacture as existing building panelboards.

.5 Panels to be factory assembled.

.6 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.7 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.8 Two keys for each panelboard and key panelboards alike.

.9 Aluminum bus with neutral of same ampere rating as mains.

.10 Mains: suitable for bolt-on breakers.

.11 Trim with concealed front bolts and hinges.

.12 Trim and door finish: to match existing.

.13 Panels are to be complete with branch breakers, spares and spaces as per Drawings.

.14 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.

.15 Panels are to be surface mount as shown.

.16 Panels to be dead front type in code gauge steel enclosures.

.17 Panels are to have mains of voltage and capacity, and main and branch breakers and contractors. Spaces to include necessary bus work such that the Owner, at a later date, need buy only the breakers.

.18 Provide isolated grounding bar in all new and existing panelboards mounted on insulators for connection from isolated ground type receptacles.

.19 Connect ground bar in each panel with minimum #1/0 green insulated ground conductors to ground bar on existing bus duct riser.

.20 Breakers to have bolted type connections. Two and three pole breakers to be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboards to height specified in Section 26 05 00 – Common Work Results – Electrical or as indicated.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

3.2 PANEL MOUNTING HEIGHT

.1 Mount electrical panels, where possible, with top of trim at uniform to match existing.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE), or most recent edition.

1.4 SUBMITTALS

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

Part 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Breakers to suit existing Electrical Distribution Panel

.2 Moulded-case circuit breakers: to CSA C22.2 No. 5

.1 Electronic trip molded case standard function 80% rated circuit breakers

.2 All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

.3 Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated drawing.

.4 Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Circuit breakers shall have a minimum interrupting capacity as per drawings.

.5 Circuit breaker manufacturer shall match existing.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers in accordance with manufacturer's instructions.

.2 Provide new doors and panels as required.

.3 Test, Commission and place into working order.

.4 Provide all Lamacoid Name Plates and permanently fix to the Distribution Board.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 11 – Cleaning.

.3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.4 Section 01 78 00 – Closeout Submittals.

.5 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters (or current edition).

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA AB 1 - Molded Case Circuit Breakers.

.2 NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

.3 NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

.4 NEMA KS 1 - Enclosed Switches.

.3 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.4 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.5 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures.

.1 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MANUAL MOTOR STARTERS

.1 Manual motor starters of size, type, rating, and enclosure type as indicated.

.2 NEMA ICS 2, AC general purpose Class A manually operated, full-voltage controller with overload element, [red pilot light,] [[NO] [NC] auxiliary contact,] and [push button] [toggle] operator.

.3 Enclosure: NEMA ICS 6; Type 1.

2.2 MAGNETIC MOTOR STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.2 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.3 Magnetic motor starters to match base building standards.

.4 Combination type starters to include unfused safety switch [with operating lever on outside of enclosure to control safety switch.

.1 Circuit breaker type combination starters shall include a thermal magnetic circuit breaker in common enclosure, and:

.1 Thermal Magnetic Circuit Breakers: NEMA AB 1circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

.2 Unfused safety switch type combination starters shall be and enclosed knife switch with externally operable handle and visible blades in common enclosure.

.5 Enclosure: NEMA Type 1.

.6 Accessories:

.1 Indicating lights: standard.

.2 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.3 Locking in "OFF" position with up to 3 padlocks.

.4 Independent locking of enclosure door.

.5 Provision for preventing switching to "ON" position while enclosure door open.

2.3 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 – Common Work Results – Electrical.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Height: 5 ft (1.6 m) to operating handle.

.3 Install and wire starters and controls as indicated.

.4 Ensure correct fuses installed in fusible safety switches.

.5 Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

.6 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 – Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results

.2 Section 26 05 21 – Wires and Cables

1.2 SECTION INCLUDES

.1 Variable speed drives for fan as indicated.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.3 No. 1-01, Overhead Systems, or most recent edition.

.3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V, or most recent edition.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide shop drawings for each type of variable speed drive to indicate:

.1 Mounting method and dimensions.

.2 Variable Speed Drive size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of variable speed drive for incorporation into maintenance manual.

Part 2 Products

2.1 VARIABLE SPEED DRIVES

.1 General

.1 Variable speed drives provided shall be the voltage, phase and size indicated on the accompanying drawings.

.2 To be mounted in a NEMA 12 ventilated metal enclosure with hinged door; Drives shall be CSA and ULC certified;

.3 Drives shall carry a minimum 2-year on-site parts and labour warranty;

.4 Rating: as per Drawings.

.5 Drives shall operate in an environment with minimum ambient temperature of 0ºC and maximum ambient temperature of 40ºC and less than 95% humidity, non-condensing.

.6 Suitable to be capable of continuous operation at a minimum of 125% of rated motor full load current.

.7 Door interlocked, padlock able circuit breaker that will disconnect all input power from the drive and all internally mounted options;

.8 Door mounted keypad with complete programmability of display, including Hand-Off-Auto, Run, Digital Speed Control on hand mode, and Help key;

.9 Real time clock including date and time stamp on all fault conditions;

.10 Drive efficiency of 97% or greater at full load;

.11 Over voltage and under voltage protection;

.12 Built in PID controller;

.13 Programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include voltage (0 to 10 V DC, 2 to 10 V DC) and current (0 to 20 mA, 4 to 20 mA) input;

.14 Programmable 0 to 20 mA analog outputs shall be provided for indication of VSD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication;

.15 Network communication with DDC system with BACnet protocol;

.16 USB port or RS232 for PC programming access;

.17 Factory wired electronic 2 contactor bypass with drive isolation disconnect switch. Overload protection shall be provided in both drive and bypass modes. When in bypass, the unit shall maintain DDC communication.

.18 Provide on cover or adjacent to each VSD an operations, laminated tips sheet. Each sheet shall include steps for general operation and methods for general operation including steps for switching to bypass. Include emergency contact information for support.

.2 Primary Protection Between VSD and Power Supply Line Reactor

.1 EMI/RFI filters to attenuate radio frequency interference conducted to the AC line.

.2 The VSD shall have a 5% impedance inductive line reactor, DC Link Choke, upstream of each VSD to reduce the harmonics to the power line and to add

protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors.

.3 Secondary Protection Between VSD and Motor (Load Reactor)

.1 Also, this is the minimum allowable if the VSD is connected to a generator. For existing motor, provide secondary protection between drive and motor to include a sinewave load reactor.

2.2 ELECTRIC MOTORS

.1 Motors shall be provided by the drive provider and shall meet the performance requirements indicated on the drawings.

.2 Motors shall be totally enclosed fan-cooled TEFC squirrel cage design, 1800 rpm, with 600V/ 3 phase electrical power supply

.3 Motors shall be premium efficiency, inverter duty rated, and constructed to NEMA MG1, part 31 requirements.

.4 Remove existing motors and turn over to the owner as per Drawings. Install the new motors with new pulleys of same size as existing. Align the motor's pulley with the existing fan pulley. Provide new belts.

.5 Warranty on motors shall be 3 years part and labour minimum.

2.3 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Supply nameplates for VSD identification. Nameplates shall indicate equipment being controlled and voltage. Fasten or cement nameplates to equipment in a conspicuous location.

Part 3 Execution

3.1 INSTALLATION

.1 Install variable speed drives and control devices in accordance with manufacturer's instructions.

.2 Confirm fan nameplate and adjust overload device to suit.

.3 Provide wiring and any additional devices required to integrate the new drives to existing DDC system and alarm system. Reroute or extend all control wiring to suit.

.4 Add a lamicoid warning label to existing MCC safety switch. Label to read as follows, "Emergency Use Only. Do not operate unless VSD has first been turned off."

.5 Where required, construct a structural mounting stand, seismically secured to floor, for the mounting of the VSD's.

.6 Remove and dispose old motor starters after the variable speed drive installation and testing.

3.2 WIRING

.1 Include for the VSD wiring and conduit installation.

.2 Use separate conduit installation for each of the following: motor wiring, fire alarm wiring, power wiring, and control wiring. Install all wiring in conduit. Flexible liquid tight flexible conduit to be used for connection to motor.

.3 Provide all required relays, contactors and equipment for interfacing any specified equipment with fire alarm system and provide verifications of system as required.

.4 Once transfer of existing power and control wiring to new VSD is complete, remove all redundant or obsolete wiring from the existing starter.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Sections 26 05 00 - Common Work Results for Electrical, 01 91 13 – Testing and Commissioning and manufacturer's instructions.

.2 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.3 An approved representative of the drive manufacturer shall set-up, start and commission the drive and fan combinations on site.

.4 A complete report with all VSD parameters and readings, which includes but not limited to VSD and accessories technical information, model and serial number, installation check-out, voltages and amperages on normal and bypass mode, motor information data, ambient and inside enclosure temperatures, measurements of the harmonics and voltage peaks at the motor, and all setup parameters, shall be submitted to the Departmental Representative.

END OF SECTION

Appendix A

Halocarbon Management Site Procedure

Halocarbon Management Site Procedure

FISHERIES AND OCEANS CANADA - PACIFIC REGION
Regional Office of Environmental Coordination

Template Version 6.0	This document is valid only at time of printing, any copies made are considered uncontrolled.	Template Date April 2020
Site Version		Site Issue Date

Table of Contents

Annexes

1.0 Purpose

The purpose of this procedure is to clearly identify the actions that sites and facilities must undertake to achieve and maintain compliance with the *Federal Halocarbon Regulations, 2003 (SOR/2003-289)* (*FHR*) and the national DFO Halocarbon Procedure.

2.0 Overview

Halocarbons are compounds that consist of carbon combined with one or more halogens such as a fluorocarbon. Halocarbons are broken down by ultraviolet radiation in the upper atmosphere and release free halogen atoms that damage the ozone layer. Halocarbons have been implicated as greenhouse gases and are becoming more heavily regulated.

3.0 Halocarbon-Containing Equipment & Systems

Halocarbons are typically found in the following **Types of Equipment**:

- Air conditioner
- Fire Extinguishing/Fire Suppression
- Refrigeration
- Solvent System (using Halocarbons)

This equipment can be further delineated into **System Types**. Each system type is described in the table below:

System Type	Description
Large Refrigeration/AC System (≥ 19kW (5.4 tons))	• A refrigeration or air conditioning system, other than one that normally operates in, on or in conjunction with a means of transportation, that has a refrigeration capacity of at or more than 19kW (5.4 tons) as rated by the manufacturer • *Examples:* ○ Main building chillers ○ Commercial freezers/refrigerators ○ Roof-top air conditions ○ Chillers ○ Heat pumps
Small Installed Refrigeration and AC System (<19 kW (5.4 tons))	• Refrigeration capacity of less than 19 kW (5.4 tons) refrigeration output capacity as rated by the manufacturer

System Type	Description

	• *Examples:*
	  ○ Heat pump
	  ○ Fixed air conditioning system with building-integrated circulation routes (non-mobile, non-window mounted)
	  ○ Chiller

Small Packaged System:	• Refrigeration capacity of less than 19kW (5.4 tons) refrigeration output capacity as rated by the manufacturer
	• Self-contained unit that can be plugged into standard outlet and does not require any re-wiring.
	• Equipment is not serviced in its lifetime.
	
	• *Examples:*
	  ○ Domestic or commercial refrigerator/freezer
	  ○ Water cooler
	  ○ Window-exhausted or mobile air conditioner

Fixed Fire-Extinguishing System	• Includes all fixed fire-extinguishing systems that contains a halocarbon fire-extinguishing agent.
	
	• *Examples:*
	  ○ Extinguishers containing FM-200
	  ○ Halon-containing fire systems

Portable Fire-Extinguishing System	• Includes all fire-extinguishing cylinders or cartridges that contain halocarbons, weigh 25kg (55 lb) or less and that can be carried or wheeled to the site of a fire.
Solvent System	• A system that uses halocarbons as solvents, including cleaning applications and associated equipment containing or designed to contain a halocarbon solvent. • *Examples:* ○ Materials washing machines (mechanical parts or tools, textiles, fabrics) which contain halon.
Vehicle	• Only applicable to vehicles that have an AC that uses halocarbons. • *Examples:* ○ Fleet or field vehicles

4.0 Halocarbon Management Tool Kit

Proper management of halocarbon containing equipment and accurate record-keeping are important requirements of the *FHR*. Therefore, a halocarbon management tool kit has been developed to ensure compliance with the administrative and record keeping requirements of the *FHR*.

Your halocarbon management tool kit should look like the one pictured in **Figure 1** and includes the following items:

- Service Log Book (Blue binder)
- Refrigerant Documentation Journal
- Refrigerant Service Record/Notification Sheets
- Inventory Tags
- Release Reports
- Disposal or Decommissioning Notices
- Service Record Posting Box
- Ownership Validation Forms (not shown in picture)
- Contractor Awareness Documents (Annex A; not shown in picture)

Documents and supplies are available from Kelsey MacKenney, Regional Office of Environmental Coordination. Contact: (604) 666-9995 or Kelsey.MacKenney@dfo-mpo.gc.ca.

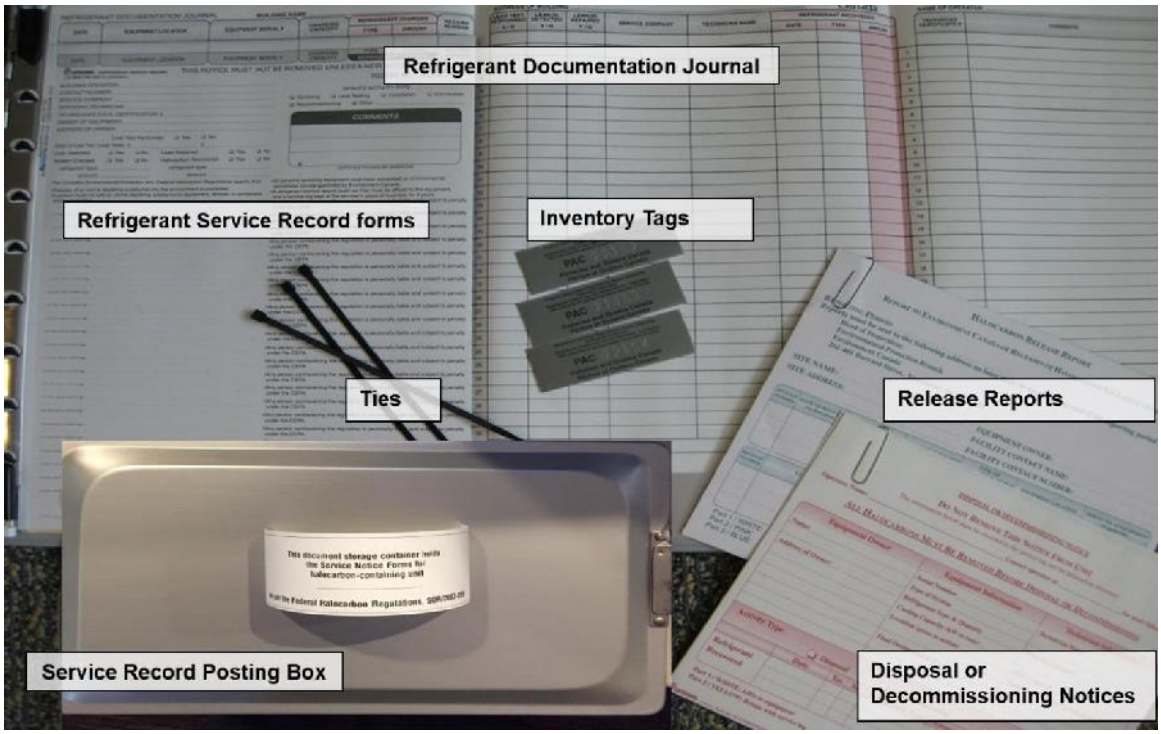


Figure 1: Halocarbon Management Tool Kit

5.0 Tagging & Inventories

All halocarbon-containing equipment (excluding small packaged systems and vehicles) must be **tagged** and **inventoried**.

Within the DFO's Pacific Region it is not mandatory for sites to include Small Packaged or motor vehicle-based halocarbon containing equipment on their halocarbon inventory . This equipment can be included in an inventory if the site prefers or if it assists with asset management. Additionally please note this equipment may be required to be tracked through other, alternative operational directions outside of ROEC.

Identification Tags: Adhesive-backed, stainless steel, sequentially numbered tags (**Figure 2**) are to be used to identify halocarbon-containing equipment. Use of plastic tags has been phased out, as these are prone to failure. Tags are to be placed in a visible location on the equipment. If you require identification tags, please contact Kelsey MacKenney with DFO's ROEC (Kelsey.MacKenney@dfo-mpo.gc.ca).

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Figure 2: DFO Pacific Halocarbon Inventory ID tag

Halocarbon Inventories: A site-specific inventory must be completed for halocarbon-containing equipment and updated when identification tags are added or replaced, equipment is added or decommissioned, or when any other inventory information is changed/added/edited.

Inventory forms are available electronically in Microsoft Excel and are broken down into four tabs; *Cover Page, HC Inventory Form, Conversion Calculators,* and *Inventory Inputs & Definitions.* A step-by-step guide to completing the inventory form is detailed below, and guidance can be found embedded within the *Inventory Inputs & Definitions* tab. **Figure 3** depicts the inventory form template when viewed using the software Microsoft Excel.

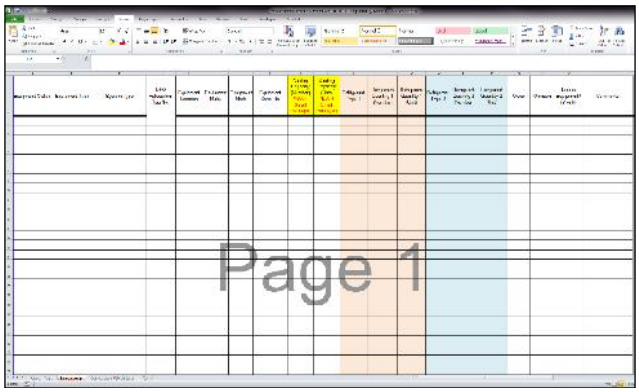


Figure 3: Halocarbon Inventory Form (*viewed with Microsoft Excel)*

Instructions for Completing a Halocarbon Inventory

Step 1:

Populate all fields on the *HC Inventory Form* tab of the inventory template for each system or piece of halocarbon containing equipment on site. If there is no computer on site, write directly on the Halocarbon Inventory Form found in Annex C of the Halocarbon Procedure.

- **Equipment Status:** Drop down field (*Active, Decommissioned, Pending Decommissioning, Sold Off as Asset,* or *Transferred Offsite*)
- **Equipment Type:** Drop down field (*Air Conditioning, Fire Extinguishing, Refrigeration,* or *Solvent System)*
- **System Type:** Drop down field (*Fixed Fire Extinguishing System (FES), Large (>19 kW), Portable Fire Extinguisher, Small Installed (<19 kW), Small Packaged (plug in), solvent system (using halocarbons),* or *Vehicle*)
- **DFO Halocarbon Tag Number:** Free text field. Enter the unique, 5-digit DFO inventory tag number (PAC XXXXX)
- **Equipment Location:** Free text field. Enter the actual physical location of the unit, please be as specific as possible
- **Equipment Make:** Free text field. Information typically located on equipment nameplate or manufacturer's decal.
- **Equipment Model:** Free text field. Information typically located on equipment nameplate or manufacturer's decal.
- **Equipment Serial Number:** Free text field. Information typically located on equipment nameplate or manufacturer's decal.
- **Refrigeration Output Capacity/Cooling Capacity (Number)**: Free Text Field. Enter the appropriate value, typically located in the equipment manual, or ask Service Technician
- **Refrigeration Output Capacity/Cooling Capacity (Unit)**: Drop down field. Select the appropriate value, typically located in the equipment manual, or ask Service Technician
- **Refrigerant Type:** Drop down field. Select the type of halocarbon/refrigerant contained in equipment (e.g. R134a) Information is typically on equipment nameplate or manufacturer's decal.
- **Refrigerant Quantity (Number):** Free Text Field. Enter the appropriate value, typically located in the equipment manual, on equipment nameplate or manufacturer's decal.
- **Refrigerant Quantity (Unit):** Drop down field. Select the appropriate value, typically located in the equipment manual, on equipment nameplate or manufacturer's decal.
- **Owner:** Drop down field. Select the department name of the person who owns the equipment (*DFO*, *CCG*, or *Other*)
- **Operator:** Drop down field. Select the department name of the person who maintains and manages the equipment (*DFO*, *CCG*, or *Other*)

- **Leased Equipment:** Drop down field. Select either *Yes* or *No* answer. (halocarbon-containing equipment may be leased from a third-party but is present on DFO/CCG property and operated by DFO/CCG, such as some water coolers.)

- **Comments:** Free text field. Please use this field to record any comments or notes about the particular halocarbon-containing system. If you changed an item's status to *Transferred Offsite*, please use this field to indicate which site it has been transferred to.

Step 2:

Ensure corresponding halocarbon tags are affixed to all applicable equipment listed on the inventory .

Step 3:

- Print out the *HC Inventory Form* tab and keep a copy in the service log, if applicable, or with the site's Environmental Management Plan (EMP)

- Inventories are to be submitted (in electronic format, preferably using Microsoft Excel) **by January 31 annually** to the Regional Office of Environmental Coordination, during Annual Environmental Reporting

NOTES

- As equipment is decommissioned or disposed, change the *Equipment Status* drop down for that system on the *HC Inventory Form* to indicate the state of the system on the inventory spreadsheet
- Do not delete information, keep systems on the inventory for 5 years after disposal.

6.0 Installation, Servicing, Leak Testing and Charging of Halocarbon and Halon-Containing Equipment

All halocarbon-containing equipment and fire extinguishing/suppression systems containing halon must be installed, serviced, leak tested and charged in accordance with the Federal Halocarbon Regulations (i.e. *FHR*; SOR 2003/289). As the requirements of the Federal Halocarbon Regulations are complex and detailed, the regional environment office (ROEC) has developed forms and specific instructions to assist staff who own or maintain halocarbon containing equipment.

As per the FHR, **only a Certified Service Technician**[1] **may install, service, leak test, charge, or do any other work that may result in the release of a halocarbon**, and they must do so in accordance with the *Refrigerant Code of Practice*[2] or *The Servicing of Halon Extinguishing Systems (ULC/ORD-C1058.18-1993)*. ROEC does not advise sites to attempt their own air-conditioner refrigerant replacement (including vehicles), as this is a direct violation of the Federal Halocarbon Regulations.

For activities related to the installation, servicing, leak testing and charging of halocarbon containing equipment, use the documentation journal and service notice forms in the blue service log book (blue binder). The **Service Log Book** (**Figure 4**) is the blue binder which holds the **Refrigerant Documentation Journal** (**Figure 5**) and **Service Notice (Refrigerant Service Record)** sheets (**Figure 6**). Each **Large Refrigeration/AC System** (>19kW (5.4 tons)) or **Fixed Fire Extinguishing/ Suppression System** should have its own service log book. However, a single log book can be used for all small equipment on site. Vehicle air-conditioning servicing does not need to be recorded in a Service Log Book, however any service records (i.e. invoices) should be maintained for 5 years.

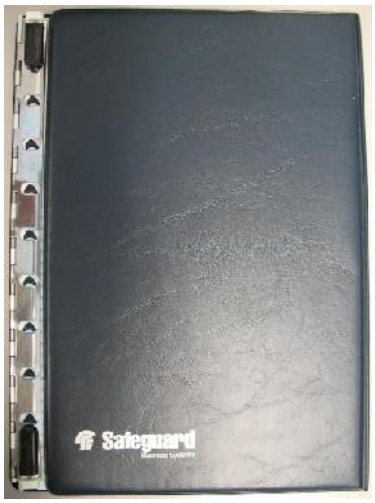


Figure 4: The halocarbon-containing equipment Service Log Book (blue binder)

[1] Certified Service Technician, someone who has completed the *Refrigeration Code of Practice* (*Environmental Awareness in Ozone Depleting Substances*) training and is trade qualified. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.

[2] "Refrigerant Code of Practice" means the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems*, published by the Department of the Environment in March, 1996, as amended from time to time

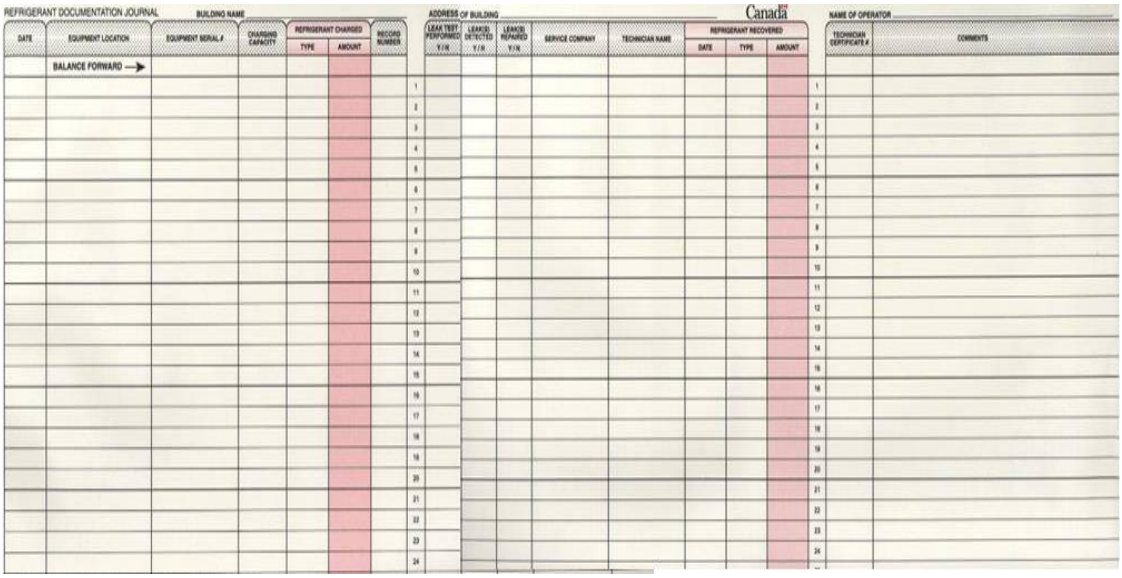


Figure 5: Refrigerant Documentation Journal, located inside the Service Log Book
(Actual size 60 cm (23 in) x 28 cm (11 in))

The **Refrigerant Documentation Journal** (**Figure 5**) is a two-piece form (**WHITE** and **YELLOW** copy) located in the service log book. The documentation journal sheets must be filled out completely, with each row of the journal corresponding to one service event (i.e. installation, leak-testing, charging, servicing, or any other work done that may result in the release of a halocarbon).

Half of the row from the journal is overlapped with the **Service Notice (Refrigerant Service Record)** form (Figure 6). This section of the journal is completed through carbon copying, and the other half of the row must be transferred from the service notice record.

As per the Federal Halocarbon Regulations (FHR), only those servicing events or installations which could result in the release of a halocarbon (i.e. FHR 9(1)) need to be done by a certified service technician, and therefore be recorded using the Refrigerant Documentation Journal and Refrigerant Service Records (as per FHR 31(1)). Servicing events which could not result in the release of a halocarbon do not require the services of a certified service technician and do not need to be recorded using the Refrigerant Documentation Journal or associated Refrigerant Service Records.

Upon filling an entire sheet, the white copy is to be retained on site for **five (5) years** and the **YELLOW** copy sent to:

Kelsey MacKenney
Regional Office of Environmental Coordination (ROEC), DFO RPSS
1120-401 Burrard Street, Vancouver, BC, V6C 3S4

Unfortunately, DFO/CCG cannot rely on contractors or certified service technicians to know/abide to all federal requirements and complete all necessary servicing records, as appropriate and in full detail. DFO and CCG are still liable for accuracy and validity of the servicing work completed and may be required to review all completed works and records prior to payment. Please be sure to provide any contractor or certified service technicians with the information in Annex A prior to any servicing event.

Installation of Systems

Based on the direction of the National Halocarbon Management Program, an installation involves the placing of a halocarbon system into service, if it requires the work of a certified person (i.e. requires work that may result in a leak, requires leak testing, requires charging, etc.). It does not include the reactivation of a system by the same owner at the same site. Additionally, it does not include plugging in small packaged systems, such as domestic refrigerators and window air-conditioning units.

As per the Federal Halocarbon Regulations, fixed installations of all halocarbon-containing equipment must be recorded in the Service Log Book by completing all the fields of the Refrigerant Documentation Journal and Service Notice (Refrigerant Service Record) sheets. Additionally, as per the Section 9 of Federal Halocarbon Regulations (FHR) any 'work that may result in the release of halocarbon', such as an installation, must be done by a Certified Service Technician[1]; conversely, any work which would not result in the release of halocarbon does not require a Certified Service Technician[1].

Small Packaged Systems do not require the installation by a Certified Service Technician since all the equipment is pre-installed at the factory and no work that is required as part of the actual mounting/installation which would result in the release of any contained halocarbon.

- Both Large and Small **Installed halocarbon-containing equipment** requires the installation services by a **Certified Service Technician**[1] . Record all information in the halocarbon Service Log Book.
- Small Packaged halocarbon-containing equipment does not require installation services by a Certified Service Technician. No information is required to be recorded in the halocarbon Service Log Book.
- Fixed Fire Extinguishing/Suppression Systems (whose cylinder or cartridge has a charging capacity of 10 kg or more) must be installed in accordance with the standards set out in the publication ULC/ORD-C1058.18-2004, of the Underwriters' Laboratories of Canada, entitled *The Servicing of Halon and Clean Agent Extinguishing Systems*.
- Any work which would not result in the release of halocarbon from the system or equipment does not require a Certified Service Technician (and does not need to be recorded using the Refrigerant Documentation Journal).
- Prior to the installation of any new Large or Small Installed halocarbon-containing equipment, contact the ROEC for information and compliance materials.

[1] Certified Service Technician, someone who has completed the *Refrigeration Code of Practice* (*Environmental Awareness in Ozone Depleting Substances*) training and is trade qualified. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.

Leak Testing and (re)Charging of Systems

Leak testing and (re)charging of halocarbon-containing equipment must be recorded in the Service Log Book by completing all the fields of the Refrigerant Documentation Journal and Service Notice (Refrigerant Service Record) sheets.

- Large Installed halocarbon-containing equipment requires the services of a **Certified Service Technician**[1] . For due diligence purposes, record the two certification numbers: the technician's *Trade Qualification Certificate*, and their *Refrigerant Code of Practice*[2] *(Environmental Awareness in Ozone Depleting Substances)* certification. This can be done in the Comments section of the Service Log Book.
- Large Installed Halocarbon-containing equipment (>19kW (5.4 tons)) and Fixed Fire Extinguishing/Suppression Systems (FES) must be leak tested once every 12 months.
- Prior to charging any halocarbon-containing system, the system must be leak tested. If a leak is detected, the equipment must not be charged. The, the owner (i.e. Real Properties) must be notified (by sending the Halocarbon Release Report to the ROEC) and the halocarbon system be repaired, isolated or the halocarbon recovered within 7 days.

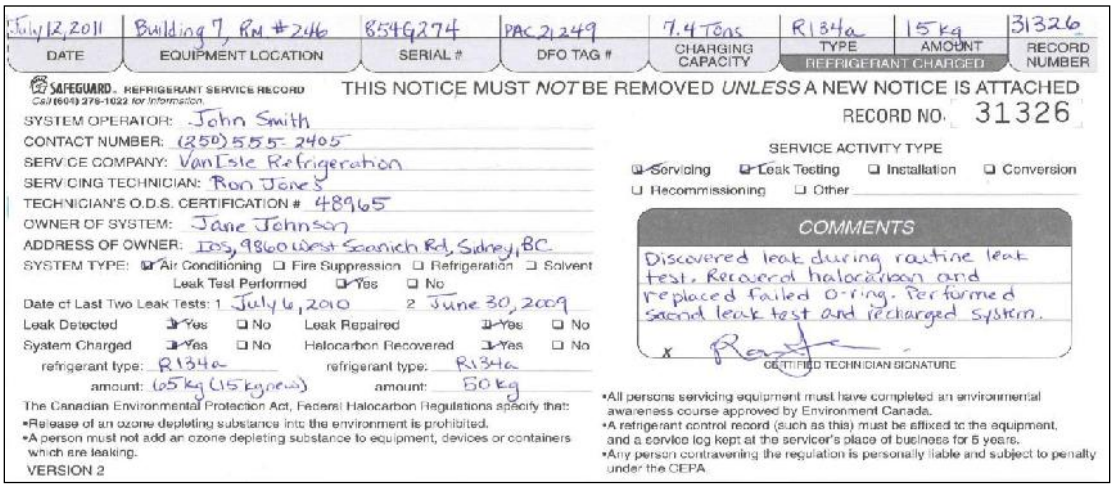
Servicing of Systems

All servicing events which may result in the release of a halocarbon from the system or equipment (e.g. Installation, Charging, Servicing, Leak Testing, Disposal, or Decommissioning) **must be recorded using the Refrigerant Documentation Journal**, inside the Service Log Book (blue binder) along with any other applicable service notice forms (i.e. Disposal/Decommissioning), and must only be done by a **Certified Service Technician**[1]. Please note that Disposal and/or Decommissioning Forms must be also be completed if applicable. Servicing events which could not result in the release of a halocarbon (i.e. electrical, or filter changes) do not need to be done by a Certified Service Technician with respect to halocarbons, nor need to be recorded in the Refrigerant Documentation Journal.

Refrigerant Service Records (Service Notices, Figure 6) are located in the halocarbon Service Log Book (blue binder). They are attached to the left side of the Service Log Book over top of the refrigerant documentation journal sheets so that the first line of the notice is carbon copied onto the corresponding line on the documentation journal page.

[1] Certified Service Technician, someone who has completed the *Refrigeration Code of Practice* (*Environmental Awareness in Ozone Depleting Substances*) training and is trade qualified. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.

[2] "Refrigerant Code of Practice" means the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems*, published by the Department of the Environment in March, 1996, as amended from time to time



DATE	EQUIPMENT LOCATION	SERIAL #	DFO TAG #	CHARGING CAPACITY	REFRIGERANT CHARGED: TYPE	REFRIGERANT CHARGED: AMOUNT	RECORD NUMBER
July 12, 2011	Building 7, Rm #246	8546274	PAC 21249	7.4 Tons	R134a	15 kg	31326

SAFEGUARD - REFRIGERANT SERVICE RECORD
Call (604) 276-1022 for information

THIS NOTICE MUST *NOT* BE REMOVED *UNLESS* A NEW NOTICE IS ATTACHED

RECORD NO. 31326

SYSTEM OPERATOR: John Smith
CONTACT NUMBER: (250) 555-2405
SERVICE COMPANY: VanIsle Refrigeration
SERVICING TECHNICIAN: Ron Jones
TECHNICIAN'S O.D.S. CERTIFICATION # 48965
OWNER OF SYSTEM: Jane Johnson
ADDRESS OF OWNER: 105, 9860 West Saanich Rd, Sidney, BC
SYSTEM TYPE: ☑ Air Conditioning ☐ Fire Suppression ☐ Refrigeration ☐ Solvent
Leak Test Performed ☑ Yes ☐ No
Date of Last Two Leak Tests: 1 July 6, 2010 2 June 30, 2009
Leak Detected ☑ Yes ☐ No Leak Repaired ☑ Yes ☐ No
System Charged ☑ Yes ☐ No Halocarbon Recovered ☑ Yes ☐ No
refrigerant type: R134a refrigerant type: R134a
amount: 65 kg (15 kg new) amount: 50 kg

The Canadian Environmental Protection Act, Federal Halocarbon Regulations specify that:
- Release of an ozone depleting substance into the environment is prohibited.
- A person must not add an ozone depleting substance to equipment, devices or containers which are leaking.

VERSION 2

SERVICE ACTIVITY TYPE
☑ Servicing ☑ Leak Testing ☐ Installation ☐ Conversion
☐ Decommissioning ☐ Other

COMMENTS
Discovered leak during routine leak test. Recovered halocarbon and replaced failed O-ring. Performed second leak test and recharged system.

x [signature] CERTIFIED TECHNICIAN SIGNATURE

- All persons servicing equipment must have completed an environmental awareness course approved by Environment Canada.
- A refrigerant control record (such as this) must be affixed to the equipment, and a service log kept at the servicer's place of business for 5 years.
- Any person contravening the regulation is personally liable and subject to penalty under the CEPA

Figure 6: Example of a completed Refrigerant Service Record (Service Notice)

The service notices (refrigerant service records) must be filled out for each service event on each piece of equipment (i.e. installation, leak-testing, charging, servicing, or any other work done that may result in the release of a halocarbon). Instructions for completing services notices are detailed below and **Figure 6** provides an example of a completed service notice (refrigerant service record).

- For due diligence purposes, record the two certification numbers: the technician's *Trade Qualification Certificate*, and their *Refrigerant Code of Practice*[1] *(Environmental Awareness in Ozone Depleting Substances)* certification. This can be done in the Comments section of the Service Log Book.
- Prior to servicing a fixed fire suppression system, the owner must be notified and a notice must be affixed to the control panel indicating that it is out of operation during the period of service.
- Once servicing has been completed, a Service Notice or Refrigerant Service Record must be completely filled out with all details, and physically affixed to the equipment and cannot be removed unless replaced by a new notice.
- Any work which would not result in the release of halocarbon from the system or equipment does not require a Certified Service Technician (and does not need to be recorded using the Refrigerant Documentation Journal).
- Vehicle air-conditioning servicing does not need to be recorded in a Service Log Book, but records (i.e. invoices) of such work should be maintained for 5 years.
- ROEC can provide protective pockets for attaching the notice/record form to the equipment. Additionally, upon request, ROEC can provide aluminum, weather-resistant Service Record Posting Boxes for exterior-located Installed halocarbon systems (**Figure 7**).

[1] "Refrigerant Code of Practice" means the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems*, published by the Department of the Environment in March, 1996, as amended from time to time

Figure 7: Example of aluminum, weather-resistant Service Record Storage Box for use with an exterior, Installed halocarbon system

Instructions for Completing a Service Notice Form (Refrigerant Service Record)

Please refer to main document for complete requirements of Certified Service Technician

Step 1:

- Hire a Certified Service Technician to undertake required servicing or leak testing. *[Note that as per the Federal Halocarbon Regulations, a Certified Service Technician is defined as someone who has completed the Refrigeration Code of Practice (Environmental Awareness in Ozone Depleting Substances) training and is trade qualified. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.]*
- Record and file the Technician's *Trade Qualification Certificate* and *Refrigeration Code of Practice* (*Environmental Awareness in Ozone Depleting Substances*) certification number.
- Provide the Service Technician with a copy of the *Contractor Awareness Document* (refer to Annex A of this Halocarbon Management Procedure)

Step 2:

Complete the **first line** of the service notice **while the record is still attached to the journal** (carbon copies).

- **Date:** Date of service event
- **Equipment Location**: Building, room, roof-top… be as specific as possible
- **Equipment Serial Number:** the serial number typically located on equipment nameplate
- **DFO Tag Number:** The DFO inventory tag number (PAC XXXXX)
- **Charging Capacity**: Typically located in the equipment manual, or ask Service Technician
- **Refrigerant Charged:** Type and amount of halocarbon added during service (*Please note that a value here indicates a loss of that amount from the system and should be inspected and reported as appropriate*)
- **Record Number**: This number is located below the cell on the Service Notice form – it provides a cross reference from the service notice to the documentation journal

Step 3:

Detach the service notice (keep for Step 4) and **then fully complete the rest of the forms**.

- **System Operator:** Name of person responsible for the on-site maintenance and management of the halocarbon-containing equipment
- **Contact Number:** Telephone number of the system operator
- **Service Company:** Name of the company employing the certified technician
- **Servicing Technician:** Name of the certified technician servicing the equipment
- **Technician's ODS Certification Number:** Number from *Environmental Awareness in ODS* course
- **Owner of System:** Person that owns the equipment (in this instance, it is the site name)
- **Address of Owner:** Site address
- **System Type:** Tick applicable box on form (system types described in Section 3 of this Procedure)
- **Comments:** Reason work performed, what work was performed, and anything else relevant to the work

Step 4:

Affix service notice (i.e. Refrigerant Service Record) **to equipment** which has been serviced, using the protective pockets or Service Record Posting Box. The latest service record (i.e. Refrigerant Service Record) for that system cannot be removed unless replaced by a new notice. Maintain all records for 5 years.

Certification Requirements of Service Technician

- As per the FHR, **only a Certified Service Technician**[1] **may install, service, leak test, charge, or do any other work that may result in the release of a halocarbon**, and they must do so in accordance with the *Refrigerant Code of Practice*[2] or *The Servicing of Halon Extinguishing Systems (ULC/ORD-C1058.18-1993)*.
- For due diligence purposes, be sure to record the technician's *Trade Qualification Certificate*, and the *Refrigeration Code of Practice*[2] (*Environmental Awareness in Ozone Depleting Substances*) certification.
- Servicing events which could not result in the release of a halocarbon (i.e. electrical) do not need to be done by a Certified Service Technician[1] with respect to halocarbons.
- Servicing of Fixed Fire Extinguishing/ Suppression System (FES) is to be done by proper fire system technician, and done so in accordance with the standards set out in the publication ULC/ORD-C1058.18-2004, of the Underwriters' Laboratories of Canada, entitled *The Servicing of Halon and Clean Agent Extinguishing Systems.*

Documentation for Servicing of Installed Systems

- Certified Service Technicians[1] must review the *Contractor Awareness Document* (**Annex A**) prior to initiating work on the system. This is an Environment Canada document that summarizes the contractor's responsibilities under the *FHR*.
- For due diligence purposes, when having Installed Systems serviced which could result in the release of a halocarbon, record the technician's two certification numbers: The technician's *Trade Qualification Certificate*, and their *Refrigeration Code of Practice*[2] *(Environmental Awareness in Ozone Depleting Substances)* certification. This can be done in the Comments section of the Service Log Book.
- Once servicing has been completed, a Service Notice or Refrigerant Service Record must be completely filled out with all details, and physically affixed to the equipment which was serviced, and cannot be removed unless replaced by a new notice. ROEC can provide protective pockets or aluminum Service Record Storage Boxes for attaching the notice to the equipment.
- Maintain all records for 5 years.
- Any work which does not result in the release of halocarbon from the system or equipment does not need to be recorded using the Refrigerant Documentation Journal.

[1] Certified Service Technician, someone who has completed the *Refrigeration Code of Practice* (*Environmental Awareness in Ozone Depleting Substances*) training and is trade qualified. In the case of CCG fleet, a trade qualified technician can be a marine engineer with a 3rd class certification with specific training on the equipment.

[2] "Refrigerant Code of Practice" means the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems*, published by the Department of the Environment in March, 1996, as amended from time to time

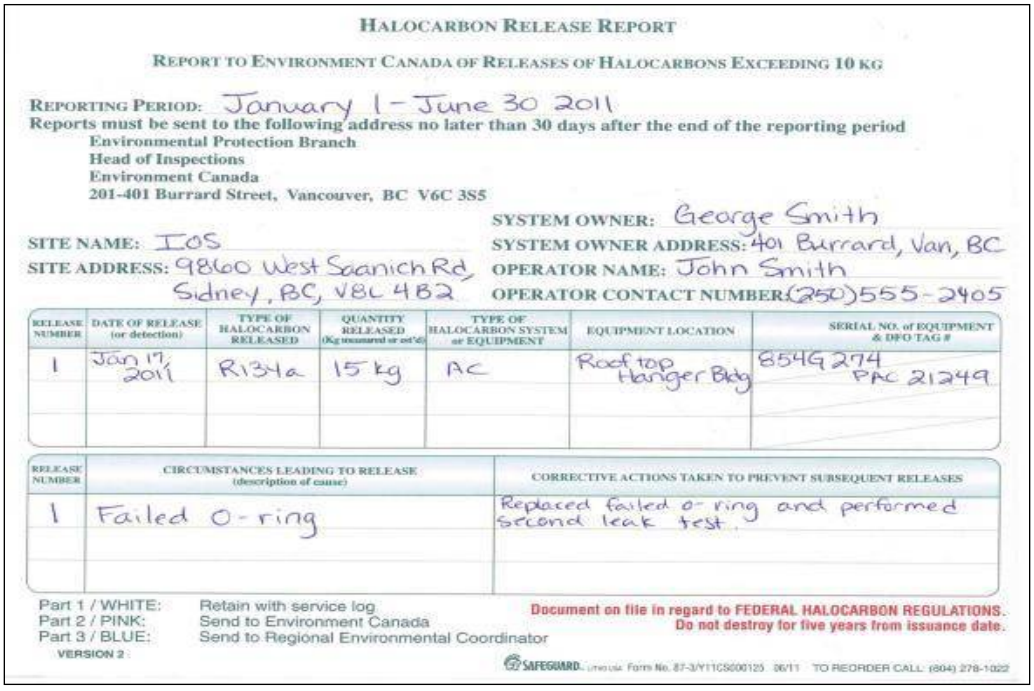
Large Installed Systems (≥19kW (5.4 tons)) and Fixed Fire Extinguishing Systems

- Each Large Installed Halocarbon-containing System or Fixed Fire Extinguishing/ Suppression System (FES) must be leak tested once every 12 months.
- Each Large Installed Halocarbon-containing System or Fixed Fire Extinguishing/ Suppression System (FES) should have its own service log book.
- Owners of Large Installed Halocarbon-containing Systems and Fixed Fire Extinguishing/ Suppression Systems (FES) are required to complete annual compliance verification paperwork. This paperwork will be sent from ROEC directly to applicable system owners, annually.
- Contact ROEC prior to the installation of any Large Installed Halocarbon-containing Systems and Fixed Fire Extinguishing/ Suppression Systems (FES) for information and any necessary or recommended compliance materials.

7.0 Release Reporting

Depending on the amount of halocarbon released, there are different reporting requirements and timelines for reporting. Instructions on when to report a release and how to complete a release report are detailed below.

The **Halocarbon Release Report (Figure 8)** is a three-piece form **(WHITE, PINK**, and **BLUE** copy). These forms are to be completely filled out when a release of halocarbon has occurred, regardless of the type of equipment or the size of the release.



HALOCARBON RELEASE REPORT

REPORT TO ENVIRONMENT CANADA OF RELEASES OF HALOCARBONS EXCEEDING 10 KG

REPORTING PERIOD: January 1 - June 30 2011
Reports must be sent to the following address no later than 30 days after the end of the reporting period
Environmental Protection Branch
Head of Inspections
Environment Canada
201-401 Burrard Street, Vancouver, BC V6C 3S5

SITE NAME: IOS
SITE ADDRESS: 9860 West Saanich Rd, Sidney, BC, V8L 4B2
SYSTEM OWNER: George Smith
SYSTEM OWNER ADDRESS: 401 Burrard, Van, BC
OPERATOR NAME: John Smith
OPERATOR CONTACT NUMBER: (250) 555-2405

RELEASE NUMBER	DATE OF RELEASE (or detection)	TYPE OF HALOCARBON RELEASED	QUANTITY RELEASED (Kg measured or est'd)	TYPE OF HALOCARBON SYSTEM or EQUIPMENT	EQUIPMENT LOCATION	SERIAL NO. of EQUIPMENT & DFO TAG #
1	Jan 17, 2011	R134a	15 kg	AC	Roof top Hanger Bldg	8546274 PAC 21249

RELEASE NUMBER	CIRCUMSTANCES LEADING TO RELEASE (description of cause)	CORRECTIVE ACTIONS TAKEN TO PREVENT SUBSEQUENT RELEASES
1	Failed O-ring	Replaced failed o-ring and performed second leak test.

Part 1 / WHITE: Retain with service log
Part 2 / PINK: Send to Environment Canada
Part 3 / BLUE: Send to Regional Environmental Coordinator
VERSION 2

Document on file in regard to FEDERAL HALOCARBON REGULATIONS.
Do not destroy for five years from issuance date.

SAFEGUARD Form No. 87-3/Y11CS000125 06/11 TO REORDER CALL: (604) 278-1022

Figure 8: Example of a completed Halocarbon Release Report

Instructions for Completing a Halocarbon Release Report

Populate all fields of the release report form:

- **Reporting Periods:** There are two reporting periods Jan 1 - June 30 and July 1 - Dec 31
- **Site Name:** Facility name
- **Site Address:** Facility address
- **System Owner:** Name of the person who owns the equipment.
- **System Owner Address:** Address of the equipment owner.
- **Operator Name:** Name of the person who manages and maintains the equipment
- **Operator Contact Number:** Number of the operator
- **Release Number:** Number of halocarbon releases (to reduce paperwork, a single form can be used to report up to 3 releases within the same reporting period)

- **Date of Release:** Date the release occurred or was detected
- **Type of Halocarbon Released:** Type of halocarbon contained in equipment (e.g. R134a)
- **Quantity Released:** Quantity of halocarbon released (Kg)
- **Type of Halocarbon System or Equipment:** AC, refrigeration, fire extinguishing, or solvent
- **Equipment Location:** Building, room, roof-top… be as specific as possible
- **Equipment Serial Number:** Serial number typically located on equipment nameplate
- **DFO Tag Number:** Record the DFO inventory tag number (PAC XXXXX)
- **Circumstances Leading to Release:** Describe cause(s) of release
- **Corrective Action Taken to Prevent Subsequent Releases:** Describe how similar releases in the future will be prevented (e.g. preventative maintenance, more leak tests, etc.)

Instructions on When and Whom to Report a Halocarbon Release

The following reporting requirements apply in the event of halocarbon release. Different reporting requirement are dependent upon amount of halocarbon released.

A) Halocarbon Releases of 100 kg (220 lb) or More:

1. **Within 24 hours** of the release discovery, verbally report the release to Emergency Management British Columbia's Provincial Emergency Program, **1-800-663-3456**

   The report must include:
   - The **DATE** and **LOCATION** of release.
   - The **TYPE OF HALOCARBON** and **AMOUNT** released.
   - And the **TYPE OF SYSTEM** from which it was released.

2. Immediately report/inform the incident to the DFO's Regional Office of Environmental Coordination:

   Kelsey MacKenney
   Regional Office of Environmental Coordination (ROEC) Fisheries and Oceans Canada, Pacific Region
   DFO Regional Head Quarters
   200 - 401 Burrard Street
   Vancouver, BC V6C 3S4

   (604) 666-9995 or Kelsey.MacKenney@dfo-mpo.gc.ca

3. **WITHIN 14 DAYS** after the day the release is detected, submit the **PINK** copy of the *Halocarbon Release Report* to Environment Canada.

Regional Director, Environmental Enforcement Division
Environment and Climate Change Canada
201-401 Burrard Street (4th floor)
Vancouver, BC. V6C 3S5

4. Send the **BLUE** copy to Kelsey MacKenney, Regional Office of Environmental Coordination, Kelsey.MacKenney@dfo-mpo.gc.ca

5. Keep the **WHITE** copy on site for 5 years.

B) Halocarbon Releases between 10 kg (22 lb) and 100 kg (220 lb):

1. According to the following schedule, send the **PINK** copy to Environment Canada **AS WELL AS** send the **BLUE** form to Kelsey MacKenney, Regional Office of Environmental Coordination (ROEC), Kelsey.MacKenney@dfo-mpo.gc.ca

    - If the release occurred between January 1 to June 30;
      Send the copies by July 31.

    - If the release occurred between July 1 to December 31;
      Send the copies by January 31.

2. Keep the **WHITE** copy on site for **5 years.**

C) Halocarbon Releases of 10 kg (22 lb) or less:

1. According to the following schedule, send the **BLUE** copy to Kelsey MacKenney, Regional Office of Environmental Coordination (ROEC), Kelsey.MacKenney@dfo-mpo.gc.ca

    - If the release occurred between January 1 – June 30;
      Send **BLUE** copy by July 31.

    - If the release occurred between July 1 – December 31;
      Send **BLUE** copy by January 31.

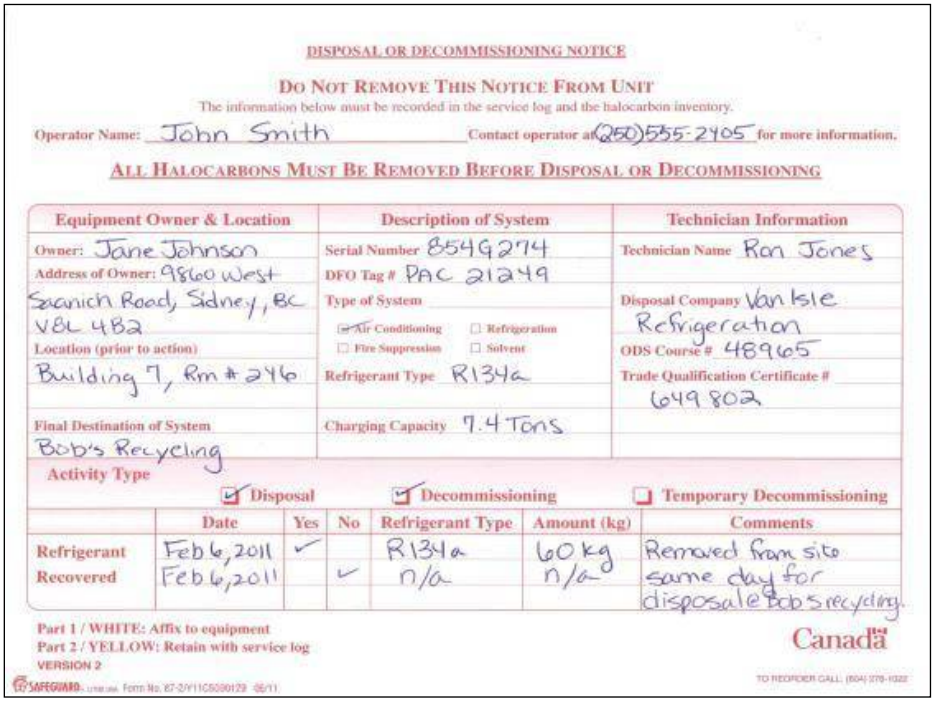
2. Keep the **WHITE** copy on site for **5 years.**

8.0 Decommissioning and Disposal

Decommissioning involves permanently or temporarily removing a halocarbon-containing system from service. When decommissioning a system, the halocarbons must be removed before the equipment is sent for disposal. Disposal involves sending or taking the decommissioned system to a disposal and recycling facility.

The **Disposal or Decommissioning Notice** is a two-part form (**WHITE** and **YELLOW**) that is to be completed for decommissioning (permanent or temporary) or disposal of halocarbon containing equipment.

The requirement to submit Disposal and Decommissioning Notices to ROEC for Small Packaged halocarbon-containing equipment disposal is not mandatory within the Pacific Region. Sites are encouraged to maintain their own records displaying environmentally sound halocarbon equipment decommissioning (removal of halocarbons) and disposal practices. Instructions for completing services notices are detailed below and **Figure 8** provides an example of a completed Disposal or Decommissioning Notice.



DISPOSAL OR DECOMMISSIONING NOTICE

DO NOT REMOVE THIS NOTICE FROM UNIT

The information below must be recorded in the service log and the halocarbon inventory.

Operator Name: John Smith Contact operator at (250) 555-2405 for more information.

ALL HALOCARBONS MUST BE REMOVED BEFORE DISPOSAL OR DECOMMISSIONING

Equipment Owner & Location	Description of System	Technician Information
Owner: Jane Johnson	Serial Number 8549274	Technician Name Ron Jones
Address of Owner: 9860 West Saanich Road, Sidney, BC V8L 4B2	DFO Tag # PAC 21249	Disposal Company Van Isle Refrigeration
Location (prior to action): Building 7, Rm # 246	Type of System: ☑ Air Conditioning ☐ Refrigeration ☐ Fire Suppression ☐ Solvent	ODS Course # 489605
	Refrigerant Type R134a	Trade Qualification Certificate # 649802
Final Destination of System: Bob's Recycling	Charging Capacity 7.4 Tons	

Activity Type: ☑ Disposal ☑ Decommissioning ☐ Temporary Decommissioning

	Date	Yes	No	Refrigerant Type	Amount (kg)	Comments
Refrigerant Recovered	Feb 6, 2011	✓		R134a	60 kg	Removed from site same day for disposal @ Bob's recycling.
	Feb 6, 2011		✓	n/a	n/a	

Part 1 / WHITE: Affix to equipment
Part 2 / YELLOW: Retain with service log
VERSION 2

Canada

Figure 9: Example of a completed Disposal or Decommissioning Notice

Instructions on Completing a Disposal or Decommissioning Notice

Step 1:

- Hire a certified technician to undertake required service including removal of halocarbons.
- Record the Technician's *Trade Qualification Certificate* number and *Refrigerant Code of Practice* (*Environmental Awareness in ODS*) number.

- Provide the Service Technician with a copy of the *Contractor Awareness Document* (refer to Annex A of this Halocarbon Management Procedure)

Step 2:
Fully complete the two-part Disposal or Decommissioning form:

- **Operator Name:** Name of operator of the decommissioned equipment
- **Contact Operator at:** Telephone number of the operator

Equipment Owner & Location
- **Owner:** Name of the person who owns the equipment.
- **Address of Owner:** Address of owner.
- **Location (prior to action):** Location of equipment before removal, as specific as possible
- **Final Destination of System:** Specific landfill or recycling depot, or other disposal location.

Description of System
- **Serial Number:** Typically located on equipment nameplate
- **Type of System:** AC, refrigeration, fire extinguishing or solvent
- **Refrigerant Type:** Type of halocarbon contained in equipment (e.g. R134a)
- **Charging Capacity:** In kW, BTU, HP, or tons

Technician Information
- **Technician Name:** Name of the certified technician decommissioning the equipment
- **Disposal Company:** Name of the company employing the certified technician
- **ODS Course Number:** Technician's certification number from Environmental Awareness in ODS course
- **Trade Qualification Certificate Number:** Certified technician's TQC number

Activity Type
- **Check one or more if applicable:**
  - **Disposal:** When disposing of a decommissioned system
  - **Decommissioning:** When decommissioning a system
  - **Temporary Decommissioning:** When decommissioning a system that will be reactivated at a later date

Refrigerant Recovered
- **Date:** Date of halocarbon recovery
- **Yes/No:** Was halocarbon recovered?
- **Refrigerant Type:** Type of halocarbon recovered if applicable (e.g. R134a)
- **Amount:** Amount of halocarbon recovered if applicable
- **Comments:** Anything relevant to the decommissioning or disposal, such as anticipated reactivation date, or disposal date if different than recovery date

Step 3:
Affix **WHITE** copy of notice to equipment and retain **YELLOW** copy on site for 5 years.

Step 4:
Update halocarbon inventory. Move information from In Use tab to Decommissioning or Disposal tab. If a release of halocarbons has been determined (i.e. refrigerant recovered was less than originally charged) a Halocarbon Release Report should also be completed and submitted to equipment's owner (refer to Section 7.0 of the Halocarbon Management Procedure for details and guidance).

9.0 Summary of General Requirements and Prohibitions

General Requirements	
All applicable halocarbon containing equipment is to be inventoried and tagged. Inventories are to be submitted to ROEC by January 31, annually during AER.	√
Before they commence any work on a halocarbon-containing system, provide the Service Technician with a copy of the *Contractor Awareness Document* (Annex A) and obtain a copy of their certification card. Only **a certified** service **technician** (see Section 6.0 for definition) may perform any work on a system which may result in the release of halocarbon/refrigerant, and work must be carried out according to the *Refrigerant Code of Practice* or *The Servicing of Halon Extinguishing Systems (ULC/ORD-C1058.18-1993)*.	√
An entry into the service log (refrigerant documentation journal) by the owner is required whenever a system is installed, serviced, leak tested, charged or if any other work is done that may cause a halocarbon release. Only a certified service technician (see Section 6.0 for definition) may perform any work on a system which may result in the release of halocarbon/refrigerant.	√
Service notices (refrigerant service records) must be filled out completely and affixed to the system after any service event including installation, a leak test, and/or before dismantling, decommissioning or destruction of the system.	√
Notices affixed to the equipment cannot be removed except to replace with another notice. Keep notices on site for minimum five (5) years.	√
Before dismantling, decommissioning, or destroying of a system, all of the halocarbon must be recovered and a decommissioning notice completed and affixed to the equipment.	√
A leak test is required before charging any system.	√
Leak tests must be done at least once every 12 months/365 days for equipment that has a cooling capacity or refrigeration output capacity equal to or over 19kW (5.4 tons) (i.e. Large systems) and for fixed halon-containing fire extinguishing systems.	√
Large System and FES Verification Forms must be completed for equipment that has a cooling capacity equal to or over 19kW (5.4 tons) (i.e. Large systems) and for fixed halon-containing fire extinguishing systems. Completed forms are to be sent to ROEC annually.	√
If a leak is found or a release occurs, you must stop the leak immediately and notify the owner. A release report is to be prepared within the required timelines.	√

General Prohibitions	
Cannot release, allow or cause the release of a halocarbon.	X
Cannot install systems that use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs, HBFCs, carbon tetrachloride or methyl chloroform.	X
Cannot charge a leaking system.	X
Cannot charge CFCs into a chiller that has undergone an overhaul. Effective Jan 1, 2015, cannot operate a chiller containing CFCs.	X
Cannot service a halocarbon containing fire-extinguishing system without notifying the owner of the intended service and affixing a notice on the control panel of the system to indicate that it is out of operation during the period of service.	X
Cannot charge a portable or fixed fire-extinguishing system with CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs.	X

10.0 Associated Training

Halocarbon Management Training
Offered by: Regional Office of Environmental Coordination
Duration: 1 Hour
Recommended frequency: Once every 5 years

To arrange for training, contact Kelsey MacKenney at (604) 666-9995 or Kelsey.MacKenney@dfo-mpo.gc.ca

11.0 Records

The following records are to be maintained and readily available on-site.

Record	Retention
Halocarbon Inventory	5 years
Service Notices (Refrigerant Service Records)	5 years
Leak Test Notices	5 years
Refrigerant Documentation Journal	5 years
Disposal or Decommissioning Notices	5 years
Release Reports	5 years
Training Records	Permanent

All records shall be kept onsite for a minimum of **five (5)** years following date of issue or more as required (human health exposure records and training records are permanent).

Annexes

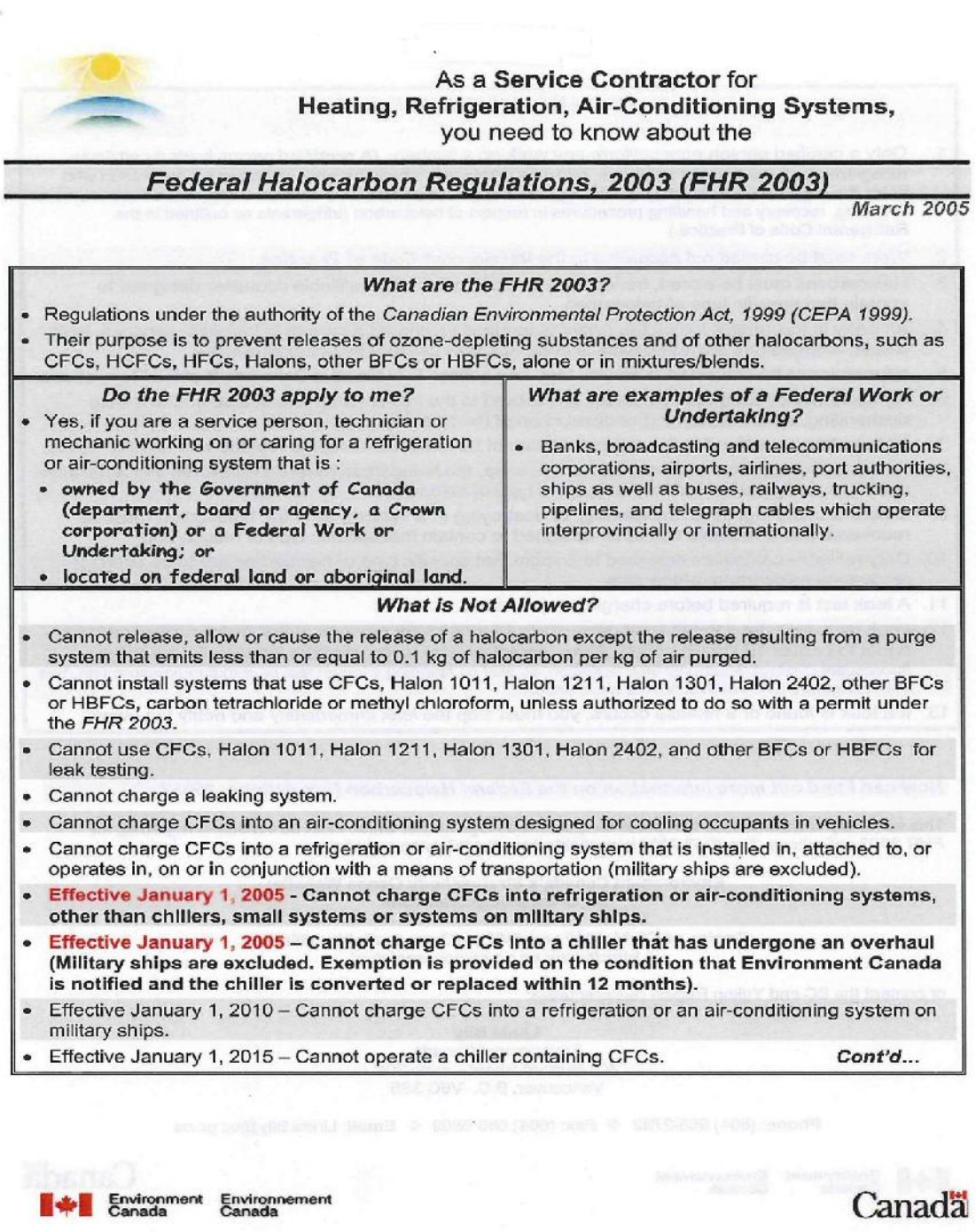
Annex A: Contractor Awareness Document

Annex B: Halocarbon (Refrigerants and Halon) Information Sheet

Annex C: Halocarbon Inventory

Annex A: Contractor Awareness Document

Please provide the following information to Service Contractors prior to servicing events.



As a **Service Contractor** for
Heating, Refrigeration, Air-Conditioning Systems,
you need to know about the

Federal Halocarbon Regulations, 2003 (FHR 2003)

March 2005

What are the FHR 2003?

- Regulations under the authority of the *Canadian Environmental Protection Act, 1999 (CEPA 1999).*
- Their purpose is to prevent releases of ozone-depleting substances and of other halocarbons, such as CFCs, HCFCs, HFCs, Halons, other BFCs or HBFCs, alone or in mixtures/blends.

Do the FHR 2003 apply to me?

- Yes, if you are a service person, technician or mechanic working on or caring for a refrigeration or air-conditioning system that is :
  - **owned by the Government of Canada (department, board or agency, a Crown corporation) or a Federal Work or Undertaking; or**
  - **located on federal land or aboriginal land.**

What are examples of a Federal Work or Undertaking?

- Banks, broadcasting and telecommunications corporations, airports, airlines, port authorities, ships as well as buses, railways, trucking, pipelines, and telegraph cables which operate interprovincially or internationally.

What is Not Allowed?

- Cannot release, allow or cause the release of a halocarbon except the release resulting from a purge system that emits less than or equal to 0.1 kg of halocarbon per kg of air purged.
- Cannot install systems that use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, carbon tetrachloride or methyl chloroform, unless authorized to do so with a permit under the *FHR 2003*.
- Cannot use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, and other BFCs or HBFCs for leak testing.
- Cannot charge a leaking system.
- Cannot charge CFCs into an air-conditioning system designed for cooling occupants in vehicles.
- Cannot charge CFCs into a refrigeration or air-conditioning system that is installed in, attached to, or operates in, on or in conjunction with a means of transportation (military ships are excluded).
- **Effective January 1, 2005 - Cannot charge CFCs into refrigeration or air-conditioning systems, other than chillers, small systems or systems on military ships.**
- **Effective January 1, 2005 – Cannot charge CFCs into a chiller that has undergone an overhaul (Military ships are excluded. Exemption is provided on the condition that Environment Canada is notified and the chiller is converted or replaced within 12 months).**
- Effective January 1, 2010 – Cannot charge CFCs into a refrigeration or an air-conditioning system on military ships.
- Effective January 1, 2015 – Cannot operate a chiller containing CFCs. ***Cont'd...***

Environment Canada Environnement Canada

Canada

What else do I need to know?

1. Only a certified person may perform any work on a system. (A **certified** person holds a certificate recognized by three or more provinces, or by the province in which the work of the service technician who holds the certificate is being done, indicating successful completion of an environmental awareness course in recycling, recovery and handling procedures in respect of halocarbon refrigerants as outlined in the Refrigerant Code of Practice.)
2. Work must be carried out according to the **Refrigerant Code of Practice**.
3. Halocarbons must be stored, transported and purchased in a refillable container designed to contain that specific type of halocarbon.
4. An entry in the service log by the owner is required whenever a system is installed, serviced, leak tested, charged or if any other work is done that may cause a halocarbon release.
5. Information to be contained in service logs and notices is outlined in Schedule 2 of the Regulations.
6. Notices must be filled out completely and affixed to the system after a leak test, and/or before dismantling, decommissioning or destruction of the system.
7. Notices that are affixed to the equipment cannot be removed except to replace with another notice.
8. Before doing any work that may cause a release, the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
9. Before dismantling, decommissioning, or destroying of a system, all of the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
10. Only refillable containers designed to contain that specific type of halocarbon are to be used for recovering halocarbon refrigerants.
11. A leak test is required before charging any system.
12. Leak tests must be done at least once every 12 months for equipment that has a cooling capacity equal to or over 19 kW (5.4 tons). **Note:** Acceptable leak testing methods includes: bubble testing, fluorescent dye test, electronic leak detection, as well as standing vacuum test or standing pressure test. See the Refrigerant Code of Practice for more details.
13. If a leak is found or a release occurs, you must stop the leak immediately and notify the owner.

How can I find out more information on the Federal Halocarbon Regulations, 2003?

This summary is **not** intended to replace the published Regulations, which must be consulted regarding full *FHR 2003* obligations. The *FHR 2003* is available from the following website:

Environment Canada's Stratospheric Ozone Website:
http://www.ec.gc.ca/ozone

Copies of *CEPA 1999* and *FHR 2003* are available online at:
http://www.ec.gc.ca/ceparegistry/

or contact the BC and Yukon Region representative:

Linda Bily
Environment Canada
401 Burrard Street – suite 201
Vancouver, B.C. V6C 3S5

Phone: (604) 666-2732 ❖ **Fax**: (604) 666-6800 ❖ **Email**: Linda.Bily@ec.gc.ca

Environment Canada Environnement Canada

Canada

As a **Service Contractor** for
Halocarbon-Containing Fire-Extinguishing Systems,
you need to know about the

Federal Halocarbon Regulations, 2003 (FHR 2003)

March 2005

What are the FHR 2003?

- Regulations under the authority of the *Canadian Environmental Protection Act, 1999 (CEPA 1999)*.
- Their purpose is to prevent releases of ozone-depleting substances and other halocarbons, such as CFCs, HCFCs, HFCs, Halons, other BFCs or HBFCs, alone or in mixtures/blends.

Do the FHR 2003 apply to me?

- Yes, if you are a service person, technician or mechanic working on or caring for a halocarbon-containing fire-extinguishing system that is:
  - **owned by the Government of Canada (department, board or agency, a Crown corporation) or a Federal Work or Undertaking; or**
  - **located on federal land or aboriginal land.**

What are examples of a Federal Work or Undertaking?

- Banks, broadcasting and telecommunications corporations, airports, airlines, port authorities, ships as well as buses, railways, trucking, pipelines, and telegraph cables which operate interprovincially or internationally.

What is Not Allowed?

- Cannot release, allow or cause the release of a halocarbon, except to fight fires that are NOT set for training purposes.
- Cannot install systems that use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, carbon tetrachloride or methyl chloroform, unless authorized to do so with a permit under the *FHR 2003*.
- Cannot charge a portable fire-extinguishing system with CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, except for use on aircraft, military vehicle or military ship.
- **Effective January 1, 2005, cannot charge a fixed fire-extinguishing system with CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, except for use on aircraft, military vehicle or military ship.**
- Cannot use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, and other BFCs or HBFCs for leak testing.
- Cannot charge a leaking system.
- Cannot service a halocarbon containing fire-extinguishing system without notifying the owner of the intended service and affixing a notice on the control panel of the system to indicate that it is out of operation during the period of service.

Cont'd ...

Environment Canada Environnement Canada

Canada

What else do I need to know?

1. Work must be done according to ***The Servicing of Halon Extinguishing Systems*** **(ULC/ORD-C1058.18-1993).**
2. Halocarbons must be stored, transported and purchased in a refillable container designed to contain that specific type of halocarbon.
3. An entry in the service log is required whenever a system is installed, serviced, leak tested, charged or if any other work is done that may cause a halocarbon release.
4. Information to be contained in service logs and notices is outlined in Schedule 2 of the Regulations.
5. Notices must be filled out completely and affixed to the system after a leak test, and/or before dismantling, decommissioning or destruction of the system.
6. Notices that are affixed to the equipment cannot be removed except to replace with another notice.
7. Before doing any work that may cause a release, the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
8. Only refillable containers designed to contain that specific type of halocarbon are to be used for recovering halocarbons.
9. Before dismantling, decommissioning or destruction of a system, all of the halocarbon must be recovered.
10. Recovery equipment used must have a transfer efficiency of at least 99% as defined in ***Halon Recovery and Reconditioning Equipment*** **(ULC/ORD-C1058.5-1993).**
11. A leak test is required before charging any system.
12. Leak tests must be done at least once every 12 months for all fire extinguishing systems, except portable fire extinguishers and systems with a charging capacity of less than 10 kg located in military vehicles.
13. If a leak is found or a release occurs, you must stop the leak immediately and notify the owner.

How can I find out more information?

This summary is **not** intended to replace the published Regulations, which must be consulted regarding full *FHR 2003* obligations. The *FHR 2003* is available from the following website:

Environment Canada's Stratospheric Ozone Website:
http://www.ec.gc.ca/ozone

Copies of *CEPA 1999* and *FHR 2003* are available online at:
http://www.ec.gc.ca/ceparegistry/

or contact the BC and Yukon Region representative:

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Environment Canada Environnement Canada

Canada

What about the BC Provincial Ozone Depleting Substances and other Halocarbons Regulation?

The *BC Ozone Depleting Substances and Other Halocarbons Regulation* (BCODSR) have similar conditions to the *FHR 2003*. The BCODSR was last amended on June 10, 2004 and the changes include new prohibitions against charging CFCs to chillers. The BCODSR is available from the following website:

http://www.qp.gov.bc.ca/statreg/reg/e/envmgmt/387%5F99.htm

or

by calling the BC Ministry of Management Services, Queens Printer at:

(250) 387-3309

For more information about the BCODSR and its amendments, please contact:

Bob Konkin
BC Ministry of Water, Land and Air Protection
PO Box 9342 Stn Prov Govt,
Victoria, BC, V8W 9M1
Phone: (250) 387-9463 ❖ **Fax**: (250) 953-3856 ❖ **Email**: Bob.Konkin@gov.bc.ca

Disclaimer:
This document explains some of the requirements of the *Federal Halocarbon Regulations, 2003* (*FHR 2003*). However, in the event of inconsistencies between this document, the *Canadian Environmental Protection Act, 1999* (*CEPA 1999*), and the *FHR 2003*, *CEPA 1999* and the *FHR 2003* will prevail.

Annex B: Halocarbon Information Sheet

Halocarbon (Refrigerants and Halon) Information Sheet

Phase-out is applicable only to a chiller with a secondary refrigerant; not applicable to small packaged units.

Phase out by 2015
Common name/ ASHRAE number
R-10
CFCs:
R-11
R-12
R-12B2
R-13
R-13B1
R-22B
R-40
R-113
R-114
R-115
R-140a
Blends:
500 (R-12/152a (73.8/26.2)
501 (R-22/12 (75.0/25.0)
502 (R-22/115 (48.8/51.2)
503 (R-23/13 (40.1/59.9)
505 (R-12/31 (78.0/22.0)
506 (R-31/114 (55.1/44.9)
Halon 1011
Halon 1211
Halon 1301
Halon 2402
Hydrobromofluorocarbons (HBFC)

*A refrigerant can be called by its chemical acronym or the letter R, for example: CFC-12 or R-12; HCFC-22 or R-22.

The most common refrigerant which will ***not*** be phased out is **R-134a.**

Recommended replacement refrigerants:
Phase Out: Replace With
R12: R134a, R407D, R413A, R600a
R22: R407C (high temp) or R404A (low temp), R410A, R417A, R290, R1270
R500: R134a, R407D
R502: R440A, R407A, R507, R290, R1270
R503: R23, R508A

Phase out by 2030		
Common name/ ASHRAE number		
HCFCs: 21,	142b	234
22	151	235
31	221	241
121	222,	242
122	223	243
123	224	244
124	225	251
131	225ca	252
132	225cb	253
133	226	261
141	231	262
141b	232	271
142	233	
HBFC-22B1		
Bromochloromethane		
Blends:		
400 R-12/114 (must be specified) (50.0/50.0) (60.0/40.0)		
401A R-22/152a/124 (53.0/13.0/34.0)		
401B R-22/152a/124 (61.0/11.0/28.0		
401C R-22/152a/124 (33.0/15.0/52.0)		
402A R-125/290/22 (60.0/2.0/38.0)		
402B R-125/290/22 (38.0/2.0/60.0)		
403A R-290/22/218 (5.0/75.0/20.0)		
403B R-290/22/218 (5.0/56.0/39.0)		
405A R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)		
406A R-22/600a/142b (55.0/4.0/41.0)		
408A R-125/143a/22 (7.0/46.0/47.0)		
409B R-22/124/142b (65.0/25.0/10.0)		
411A R-1270/22/152a (1.5/87.5/11.0)		
411B R-1270/22/152a (3.0/94.0/3.0)		
412A R-22/218/143b (70.0/5.0/25.0 k		
414A R-22/124/600a/142b (51.0/28.5/4.0/16.5)		
414B R-22/124/600a/142b (50.0/39.0/1.5/9.5)		
415A R-22/152a (82.0/18.0)		
415B R-22/152a (25.0/75.0)		
416A R-134a/124/600 (59.0/39.5/1.5)		
418A R-290/22/152a (1.5/96.0/2.5)		
420A R-134a/142b (88.0/12.0)		
509A R-22/218 (44.0/56.0)		

Fisheries and Oceans Canada - Regional Office of Environmental Coordination

Annex C: Halocarbon Inventory

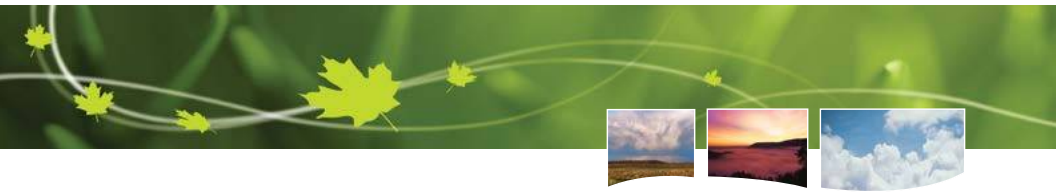
Halocarbon Inventory

Appendix B

What You Need to Know About the Federal Halocarbon Regulations, 2003

Environment Canada Environnement Canada

2012 REVISED VERSION



Environmental protection on federal and Aboriginal lands – a guide for individuals and organizations

What you need to know about the

Federal Halocarbon Regulations, 2003

Refrigeration and air-conditioning systems

Fire-extinguishing systems

Solvent systems

Warning: This document is provided for information purposes only. It does not cover all of the matters addressed in the *Federal Halocarbon Regulations, 2003*. In case of discrepancy between this document and the Regulations, the official version of the Regulations prevails.

Canada

What are the Federal Halocarbon Regulations, 2003*?*

The *Federal Halocarbon Regulations, 2003* (FHR 2003) were published on August 13, 2003, under the authority of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) as part of Canada's commitment to protect the Earth's ozone layer.

Environment Canada administers and enforces the FHR 2003. The purpose of the FHR 2003 is to reduce and prevent emissions of halocarbons into the environment from air-conditioning, refrigeration, fire-extinguishing and solvent systems, and from equipment associated with these systems, including storage containers. The FHR 2003 apply to those systems owned by Her Majesty in right of Canada, federal departments, agencies, boards, crown corporations, or federal works and undertakings, and those systems that are located on federal or Aboriginal lands.

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Part II
OTTAWA, AUGUST 27, 2003

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OTTAWA, 27 AOÛT, 2003

NOTICE TO READERS

The *Canada Gazette* is published under authority of the *Statutory Instruments Act*. It consists of three parts as described below:

Part I — Material required by federal statute or regulation to be published in the *Canada Gazette* other than items stipulated for Parts II and III below — Published every Saturday

Part II — Statutory Instruments (Regulations) and other classes

AVIS AU LECTEUR

La *Gazette du Canada* est publiée conformément aux dispositions de la *Loi sur les textes réglementaires*. Elle est composée des trois parties suivantes

Partie I — Textes devant être publiés dans la *Gazette du Canada* conformément aux exigences d'une loi fédérale ou d'un règlement fédéral et qui ne satisfont pas aux critères des Parties II et III — Publiée le samedi

Partie II — Textes réglementaires (Règlements) et autres catégories

How do the Federal Halocarbon Regulations, 2003 *prevent and minimize releases of halocarbons?*

The regulations:

- require preventive maintenance
- set prohibitions and restrictions
- phase out the use of some substances

Full text of the *Federal Halocarbon Regulations, 2003* is available at:

http://laws.justice.gc.ca/eng/SOR-2003-289/index.html

http://ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=75

What are halocarbons?

Halocarbons are:

- synthetic chemical compounds made up of carbon and one or more halogens (chlorine, bromine and fluorine)
- used as refrigerants, fire-extinguishing agents, solvents, foam-blowing agents and fumigants
- common halocarbons include chlorofluorocarbons **(CFCs)**, hydrochlorofluorocarbons **(HCFCs)**, **halons**, hydrofluorocarbons **(HFCs)** and perfluorocarbons **(PFCs)**

Why are halocarbons controlled?

Emissions of halocarbons can lead to ozone depletion and contribute to climate change. Preventing halocarbon emissions provides a dual benefit for both ozone layer protection and the fight against climate change.

Schedule 1 List of halocarbons from *Federal Halocarbon Regulations, 2003*

HALOCARBONS

1. **Carbon tetrachloride**
2. **Methyl chloroform**
3. **CFCs – chlorofluorocarbons**
4. **Halon 1211 – bromochlorodifluoromethane**
5. **Halon 1301 – bromotrifluoromethane**
6. **Halon 2402 – dibromotetrafluoroethane**
7. **Bromofluorocarbons other than in 4–6**
8. **Halon 1011 – bromochloromethane**
9. **HBFCs – hydrobromofluorocarbons**
10. **HCFCs – hydrochlorofluorocarbons**
11. **HFCs – hydrofluorocarbons**
12. **PFCs – perfluorocarbons**

- **Chemicals with chlorine or bromine cause ozone depletion.**
- **All halocarbons are greenhouse gases.**

What is the impact of halocarbons?

The ozone layer is beneficial to life on Earth, as it absorbs harmful ultraviolet (UV) radiation from the sun. Halocarbons with chlorine or bromine cause ozone depletion, a decrease in the density of the ozone layer. As the ozone layer is depleted, increasing amounts of UV rays reach the Earth.

In addition to most halocarbons being ozone depleters, all halocarbons are greenhouse gases. Emissions of greenhouse gases due to human activities disrupt the natural balance of energy in the atmosphere and can significantly alter the climate on Earth.

What are the potential impacts of ozone depletion?

Ozone depletion may lead to:

- increase in UV-B radiation, resulting in a decline in the health of humans and other organisms
- increase in sunburns, skin cancer and cataracts
- humans and other organisms developing weakened immune systems
- decline in natural resources (fisheries, agriculture and forestry)

Ozone depletion

A sustained 10 percent depletion of the ozone layer would lead to a 26 percent increase in non-melanoma skin cancer. This could mean an additional 300 000 cases per year worldwide.[1]

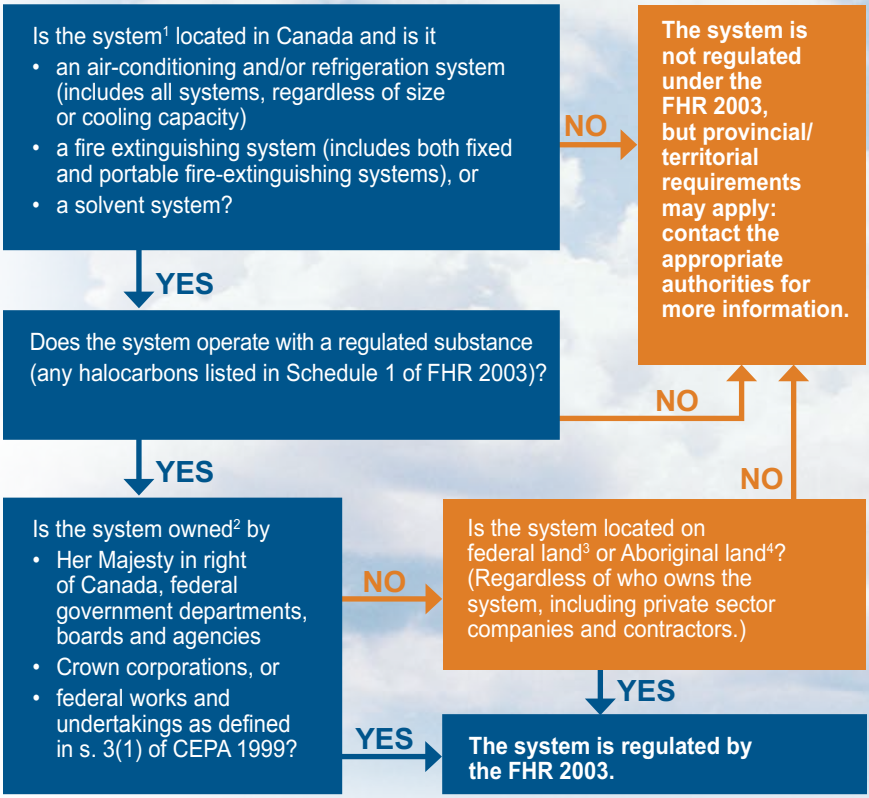
A sustained 10 percent thinning of the ozone layer would cause up to 1.75 million new cases of cataracts worldwide each year.[1]

Both humans and animals will experience an increase in skin cancers and cataracts.

1. Source: UN Environment Programme. *Environmental effects of ozone depletion: 1991 update.* Nairobi: UNEP. 1991.

Do the Federal Halocarbon Regulations, 2003 *apply to your situation?*

The following decision table will help you determine if the *Federal Halocarbon Regulations, 2003* (FHR 2003) apply to your system(s).



1. "**system**", unless the context requires otherwise, means an air-conditioning system, a fire-extinguishing system, a refrigeration system or a solvent system [including any associated equipment such as containers]. [FHR 2003]

2. "**owner**" means to hold a right in or to have possession, control or custody of, to be responsible for the maintenance, operation or management of, or to have the power to dispose of, a system. [FHR 2003]

3. "**federal land**" means

(*a*) land, including any water, that belongs to Her Majesty in right of Canada, or that Her Majesty in right of Canada has the right to dispose of, and the air and all layers of the atmosphere above and the subsurface below that land; and

(*b*) the following land and areas, namely,

(i) the internal waters of Canada as determined under the *Oceans Act*, including the seabed and subsoil below and the airspace above those waters, and

(ii) the territorial sea of Canada as determined under the *Oceans Act*, including the seabed and subsoil below and the air and all layers of the atmosphere above that sea. [CEPA 1999]

4. "**aboriginal land**" means

(*a*) reserves, surrendered lands and any other lands that are set apart for the use and benefit of a band and that are subject to the *Indian Act*;

(*b*) land, including any water, that is subject to a comprehensive or specific claim agreement, or a self-government agreement, between the Government of Canada and aboriginal people where title remains with Her Majesty in right of Canada; and

(*c*) air and all layers of the atmosphere above and the subsurface below land mentioned in paragraph (*a*) or (*b*). [CEPA 1999]

Federal Halocarbon Regulations, 2003
halocarbon system categories

The FHR 2003 apply to all refrigeration, air-conditioning and fire-extinguishing systems, including their associated equipment and devices, that contain or are designed to contain a halocarbon. They also apply to solvent systems that use halocarbons as a solvent. The following table can be used as a reference for system descriptions when interpreting the FHR 2003.

Refrigeration and air-conditioning system descriptions	
refrigeration or air-conditioning systems	- systems that contain or are designed to contain a halocarbon refrigerant
	- includes any associated equipment
small refrigeration or air-conditioning system	- has a refrigeration capacity of less than 19 kW*
	- **does not apply** to systems associated with a means of transportation
chiller	- has a compressor, an evaporator and a secondary refrigerant
motor vehicle air-conditioning system	- air-conditioning system designed for the occupants of a motor vehicle
mobile refrigeration system	- refrigeration system that is associated with a means of transportation
	- **does not** include chillers

Fire-extinguishing system descriptions	
fire-extinguishing systems	- portable or fixed fire extinguishing equipment, including any associated equipment, that contains or is designed to contain a halocarbon fire-extinguishing agent
portable fire-extinguisher	- a cylinder or cartridge that has a charging capacity of 25 kg or less and that can be carried or wheeled to the site of a fire

Solvent system descriptions
- applications or systems that use halocarbons as solvents, including cleaning applications
- **does not** include laboratory analytical standards or laboratory reagents

converting refrigeration capacity:
19 kW = 5.4 tons = 64 828 BTU/hr = 25.5 hp

What do I need to know to make sure I comply with the Federal Halocarbon Regulations, 2003*?*

General prohibitions against releasing halocarbons

You cannot release a halocarbon from a:

- refrigeration or air-conditioning system, except from a purge system that emits less than 0.1 kg of halocarbons per kg of air purged
- fire-extinguishing system, except during recovery with a maximum release of less than one percent
- container or equipment used in the re-use, recycling, reclamation or storage of a halocarbon

HCFC 123 chiller

There are only a few circumstances where a release is not a violation, including:

- use of a halocarbon fire-extinguishing system to fight a real fire (cannot be used for training purposes)
- charging a leaking refrigeration, air-conditioning or fire-extinguishing system to prevent immediate danger to human life or health (The leak must be fixed as soon as possible, and Environment Canada must be notified of the leak, the nature of the danger and the work done to rectify the leak.)

Large rooftop air conditioner

Rooftop cooling unit compressors

Purge capture device

Walk-in refrigerator compressors

Recovering halocarbons

- Halocarbons must always be recovered:
  - when installing, servicing, leak testing, charging or doing any other work that could result in a release
  - if a system is leaking
  - before a system is decommissioned, dismantled or destroyed
- For refrigeration and air-conditioning systems, halocarbon recovery must be done in accordance with *Environment Canada's Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (Refrigerant Code of Practice).
- For fire-extinguishing systems, halocarbon recovery shall be performed in accordance with the standard *Halocarbon Clean Agent Recovery and Reconditioning Equipment* (ULC/ORD-C1058.5-2004).
- Halocarbons must always be stored, purchased, transported and recovered in containers designed and manufactured to be refilled and to contain that specific type of halocarbon.

Recovery cylinder

Refrigerant cylinders

Requirements for refrigeration and air-conditioning systems

Servicing

- Work on air-conditioning or refrigeration systems must be done according to the Refrigerant Code of Practice.
- Any work that could result in a release of a halocarbon must be done by a certified person.
- The owner must maintain a service log.

Leak testing

- Required once every 12 months except for small systems and motor vehicle air-conditioning systems.
- Required before charging.
- The certified person who conducts a leak test must attach a leak test notice to the system. The owner must also keep a record of this information.
- Chlorofluorocarbons cannot be used for leak testing.

What do I do if I find a leak?

If a leak is detected:

- Notify the owner of the system
- The owner must
  - repair the leak, or
  - isolate the leaking portion and recover halocarbon from that portion, or
  - recover the halocarbon from the system

Air conditioning evaporator

Chlorofluorocarbons

Chlorofluorocarbons cannot be used to charge:

- a motor vehicle air-conditioning system
- a mobile refrigeration system
- any air-conditioning or refrigeration systems other than a small system
- a system on a military ship
- a chiller which has undergone an overhaul as described in the FHR 2003

Requirements for fire-extinguishing systems

Servicing

- Work on fire-extinguishing systems must be done according to the Underwriters Laboratories of Canada (ULC) documents: *Halon and Halocarbon Clean Agent Recovery and Reconditioning Equipment* (ULC/ORD-C1058.5-2004) and *The Servicing of Halon and Clean Agent Extinguishing Systems* (ULC/ORD-C1058.18-2004), as applicable.
- Service may be done by in-house staff or contractors.
- Before a system is serviced, a notice must be affixed to the control panel to indicate that it is out of operation during the service period, with the exception of portable fire extinguishers.
- The owner must maintain a service log.

Portable fire extinguisher

Leak testing

- Required once every 12 months except for portable fire extinguishers.
- Required before charging.
- Halons cannot be used for leak testing.


Showerhead of fire extinguishing system

What do I do if I find a leak?

In case of a leak, the requirements for air-conditioning and refrigeration systems also apply to fire-extinguishing systems (see previous related section under "Requirements for refrigeration and air-conditioning systems").

Halons

Halons cannot be used to charge a portable fire extinguisher or a fixed fire-extinguishing system.

Systems that are excluded from the charge prohibition include:

- systems for aircraft, military vehicles and military ships
- systems for which a permit has been obtained from Environment Canada

Requirements for solvent systems

- It is prohibited to:
  - use tetrachloromethane (carbon tetrachloride), 1,1,1-trichloroethane (methylchloroform) or CFCs as solvents
  - install or use a system using hydrofluorocarbons (HFCs) or perfluorocarbons (PFCs) unless a permit has been obtained from Environment Canada
- The owner must maintain a service log whenever the system is charged with more than 10 kg of halocarbons.

Additional requirements

Installation

Unless authorized by a permit issued by Environment Canada, it is prohibited to install a refrigeration, air-conditioning or fire-extinguishing system that operates with a halocarbon other than HCFCs, HFCs and PFCs.

Release reporting

The owner of the system must report all halocarbon releases over 10 kg. In the case of a release of 100 kg or more, a verbal or written report must be submitted within 24 hours followed by a written report within 14 days of detecting the release. Written reports for releases of more than 10 kg and less than 100 kg must be submitted semi-annually as follows:

- releases that occur between January 1st and June 30th must be submitted by July 30th
- releases that occur between July 1st and December 31st must be submitted by January 30th

Please refer to the telephone numbers and mailing addresses for release reporting in this Guide (page 15), for where to call in a release report and where to submit written release reports. Release reports must include the information prescribed in Schedule 2 of the FHR 2003.

Record keeping

All logs, notices, records and reports must be kept for five years at the site where the system is located. If the system is located on a means of transportation or on unoccupied premises, the documentation may be kept at a single location occupied by the owner. Owners are also required to submit a report of their systems that are located on unoccupied sites to Environment Canada.

The information that must be included in the documentation is found in Schedule 2 of the FHR 2003. Examples of forms for notices, service logs and release reports can be obtained from Environment Canada.

Advice for when you are dealing with a contractor

When issuing a contract, ensure that the terms and conditions are clearly described.

For example, for refrigeration and air-conditioning service specify:

- all work must comply with the FHR 2003 and the Refrigerant Code of Practice and any other applicable federal or provincial/territorial regulations
- a copy of the Environmental Awareness Course Certificate and Trade Qualification Certificate must be supplied for each individual who will work on the system

For fire-extinguishing system service specify:

- all work must comply with the FHR 2003 and the requirements of ULC standards ULC/ORD-C1058.18-2004 and ULC/ORD-C1058.5-2004 as applicable and with all the other standards referenced therein.

Keep in mind:

- each province has its own version of the Trade Qualification Certificate for any given trade
- while the FHR 2003 does not require use of a service company certified by ULC for work on a fire-extinguishing system, the work must be done in accordance with the ULC standards mentioned above

What does Environment Canada do to verify that individuals and organizations are complying with the Federal Halocarbon Regulations, 2003*?*

Regulatory compliance

Environment Canada's enforcement officers undertake regular inspections in order to verify compliance with the requirements of CEPA 1999 and the FHR 2003. Investigations are also conducted when an enforcement officer has reasonable grounds to believe that a violation has occurred.

CEPA 1999 provides for measures ranging from a warning to imprisonment. The choice of the enforcement action is based on principles founded in law and framed by the criteria assessment defined in the *Compliance and Enforcement Policy for the Canadian Environmental Protection Act, 1999*.

www.ec.gc.ca/CEPARegistry/documents/policies/candepolicy/toc.cfm

Federal Halocarbon Regulations, 2003 – *Halocarbon release reporting*

Contact information for where halocarbon releases subject to the FHR 2003 shall be reported

Release Reporting		
Geographic Region	Emergency Number (verbal reporting)	Mailing Address (written reporting)
Newfoundland and Labrador	1-800-563-9089	Regional Director Environmental Enforcement Division Environment Canada 16th floor, Queen Square 45 Alderney Drive Dartmouth NS B2Y 2N6 Fax: 902-426-7924 Email: fhr2003@ec.gc.ca
Prince Edward Island Nova Scotia New Brunswick	1-800-565-1633	
Quebec	1-866-283-2333	Regional Director Environmental Enforcement Division Environment Canada 105 McGill Street (3rd floor) Montréal QC H2Y 2E7 Fax: 514-496-2087 Email: InstalFed.Dale-RQ@ec.gc.ca
Ontario	1-800-268-6060	Regional Director Environmental Enforcement Division Environment Canada 845 Harrington Court Burlington ON L7N 3P3 Fax: 905-333-3952 Email: FHR.Ontario@ec.gc.ca
Manitoba Saskatchewan Alberta Northwest Territories Nunavut	204-944-4888 1-800-667-7525 1-800-222-6514 867-920-8130 867-920-8130	Regional Director Environmental Enforcement Division Environment Canada Twin Atria Building 4999-98th Avenue NW, Room 200 Edmonton AB T6B 2X3 Fax: 780-495-2451 Email: FHR2003.EED-PNR@ec.gc.ca
British Columbia Yukon	1-800-663-3456 867-667-7244	Regional Director Environmental Enforcement Division Environment Canada 201-401 Burrard Street (4th floor) Vancouver BC V6C 3S5 Fax: 604-666-9059 Email: FHR.PYR@ec.gc.ca

For information about the *Federal Halocarbon Regulations, 2003*, visit Environment Canada's stratospheric ozone website:

www.ec.gc.ca/ozone

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Appendix C

Environmental Management Plan (EMP) – Contractor Awareness Document

Annex A: Contractor Awareness Document

Please provide the following information to Service Contractors prior to servicing events.

As a **Service Contractor** for
Heating, Refrigeration, Air-Conditioning Systems,
you need to know about the

Federal Halocarbon Regulations, 2003 (FHR 2003)

March 2005

What are the FHR 2003?

- Regulations under the authority of the *Canadian Environmental Protection Act, 1999 (CEPA 1999)*.
- Their purpose is to prevent releases of ozone-depleting substances and of other halocarbons, such as CFCs, HCFCs, HFCs, Halons, other BFCs or HBFCs, alone or in mixtures/blends.

Do the FHR 2003 apply to me?

- Yes, if you are a service person, technician or mechanic working on or caring for a refrigeration or air-conditioning system that is :
  - **owned by the Government of Canada (department, board or agency, a Crown corporation) or a Federal Work or Undertaking; or**
  - **located on federal land or aboriginal land.**

What are examples of a Federal Work or Undertaking?

- Banks, broadcasting and telecommunications corporations, airports, airlines, port authorities, ships as well as buses, railways, trucking, pipelines, and telegraph cables which operate interprovincially or internationally.

What is Not Allowed?

- Cannot release, allow or cause the release of a halocarbon except the release resulting from a purge system that emits less than or equal to 0.1 kg of halocarbon per kg of air purged.
- Cannot install systems that use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, carbon tetrachloride or methyl chloroform, unless authorized to do so with a permit under the *FHR 2003*.
- Cannot use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, and other BFCs or HBFCs for leak testing.
- Cannot charge a leaking system.
- Cannot charge CFCs into an air-conditioning system designed for cooling occupants in vehicles.
- Cannot charge CFCs into a refrigeration or air-conditioning system that is installed in, attached to, or operates in, on or in conjunction with a means of transportation (military ships are excluded).
- **Effective January 1, 2005 - Cannot charge CFCs into refrigeration or air-conditioning systems, other than chillers, small systems or systems on military ships.**
- **Effective January 1, 2005 – Cannot charge CFCs into a chiller that has undergone an overhaul (Military ships are excluded. Exemption is provided on the condition that Environment Canada is notified and the chiller is converted or replaced within 12 months).**
- Effective January 1, 2010 – Cannot charge CFCs into a refrigeration or an air-conditioning system on military ships.
- Effective January 1, 2015 – Cannot operate a chiller containing CFCs.

Cont'd...

Environment Canada Environnement Canada

Canada

What else do I need to know?

1. Only a certified person may perform any work on a system. (A **certified** person holds a certificate recognized by three or more provinces, or by the province in which the work of the service technician who holds the certificate is being done, indicating successful completion of an environmental awareness course in recycling, recovery and handling procedures in respect of halocarbon refrigerants as outlined in the Refrigerant Code of Practice.)
2. Work must be carried out according to the **Refrigerant Code of Practice**.
3. Halocarbons must be stored, transported and purchased in a refillable container designed to contain that specific type of halocarbon.
4. An entry in the service log by the owner is required whenever a system is installed, serviced, leak tested, charged or if any other work is done that may cause a halocarbon release.
5. Information to be contained in service logs and notices is outlined in Schedule 2 of the Regulations.
6. Notices must be filled out completely and affixed to the system after a leak test, and/or before dismantling, decommissioning or destruction of the system.
7. Notices that are affixed to the equipment cannot be removed except to replace with another notice.
8. Before doing any work that may cause a release, the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
9. Before dismantling, decommissioning, or destroying of a system, all of the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
10. Only refillable containers designed to contain that specific type of halocarbon are to be used for recovering halocarbon refrigerants.
11. A leak test is required before charging any system.
12. Leak tests must be done at least once every 12 months for equipment that has a cooling capacity equal to or over 19 kW (5.4 tons). **Note:** Acceptable leak testing methods includes: bubble testing, fluorescent dye test, electronic leak detection, as well as standing vacuum test or standing pressure test. See the Refrigerant Code of Practice for more details.
13. If a leak is found or a release occurs, you must stop the leak immediately and notify the owner.

How can I find out more information on the Federal Halocarbon Regulations, 2003?

This summary is **not** intended to replace the published Regulations, which must be consulted regarding full *FHR 2003* obligations. The *FHR 2003* is available from the following website:

Environment Canada's Stratospheric Ozone Website:
http://www.ec.gc.ca/ozone

Copies of *CEPA 1999* and *FHR 2003* are available online at:
http://www.ec.gc.ca/ceparegistry/

or contact the BC and Yukon Region representative:

Linda Bily
Environment Canada
401 Burrard Street – suite 201
Vancouver, B.C. V6C 3S5

Phone: (604) 666-2732 ❖ **Fax**: (604) 666-6800 ❖ **Email**: Linda.Bily@ec.gc.ca

Environment Canada Environnement Canada

Canada

As a **Service Contractor** for
Halocarbon-Containing Fire-Extinguishing Systems,
you need to know about the

Federal Halocarbon Regulations, 2003 (FHR 2003)

March 2005

What are the FHR 2003?

- Regulations under the authority of the *Canadian Environmental Protection Act, 1999 (CEPA 1999).*
- Their purpose is to prevent releases of ozone-depleting substances and other halocarbons, such as CFCs, HCFCs, HFCs, Halons, other BFCs or HBFCs, alone or in mixtures/blends.

Do the FHR 2003 apply to me?

- Yes, if you are a service person, technician or mechanic working on or caring for a halocarbon-containing fire-extinguishing system that is:
  - **owned by the Government of Canada (department, board or agency, a Crown corporation) or a Federal Work or Undertaking; or**
  - **located on federal land or aboriginal land.**

What are examples of a Federal Work or Undertaking?

- Banks, broadcasting and telecommunications corporations, airports, airlines, port authorities, ships as well as buses, railways, trucking, pipelines, and telegraph cables which operate interprovincially or internationally.

What is Not Allowed?

- Cannot release, allow or cause the release of a halocarbon, except to fight fires that are NOT set for training purposes.
- Cannot install systems that use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, carbon tetrachloride or methyl chloroform, unless authorized to do so with a permit under the *FHR 2003.*
- Cannot charge a portable fire-extinguishing system with CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, except for use on aircraft, military vehicle or military ship.
- **Effective January 1, 2005, cannot charge a fixed fire-extinguishing system with CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, other BFCs or HBFCs, except for use on aircraft, military vehicle or military ship.**
- Cannot use CFCs, Halon 1011, Halon 1211, Halon 1301, Halon 2402, and other BFCs or HBFCs for leak testing.
- Cannot charge a leaking system.
- Cannot service a halocarbon containing fire-extinguishing system without notifying the owner of the intended service and affixing a notice on the control panel of the system to indicate that it is out of operation during the period of service.

Cont'd ...

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Canada

What else do I need to know?

1. Work must be done according to ***The Servicing of Halon Extinguishing Systems*** **(ULC/ORD-C1058.18-1993).**
2. Halocarbons must be stored, transported and purchased in a refillable container designed to contain that specific type of halocarbon.
3. An entry in the service log is required whenever a system is installed, serviced, leak tested, charged or if any other work is done that may cause a halocarbon release.
4. Information to be contained in service logs and notices is outlined in Schedule 2 of the Regulations.
5. Notices must be filled out completely and affixed to the system after a leak test, and/or before dismantling, decommissioning or destruction of the system.
6. Notices that are affixed to the equipment cannot be removed except to replace with another notice.
7. Before doing any work that may cause a release, the halocarbon must be recovered into a refillable container designed to contain that specific type of halocarbon.
8. Only refillable containers designed to contain that specific type of halocarbon are to be used for recovering halocarbons.
9. Before dismantling, decommissioning or destruction of a system, all of the halocarbon must be recovered.
10. Recovery equipment used must have a transfer efficiency of at least 99% as defined in ***Halon Recovery and Reconditioning Equipment*** **(ULC/ORD-C1058.5-1993).**
11. A leak test is required before charging any system.
12. Leak tests must be done at least once every 12 months for all fire extinguishing systems, except portable fire extinguishers and systems with a charging capacity of less than 10 kg located in military vehicles.
13. If a leak is found or a release occurs, you must stop the leak immediately and notify the owner.

How can I find out more information?

This summary is **not** intended to replace the published Regulations, which must be consulted regarding full *FHR 2003* obligations. The *FHR 2003* is available from the following website:

Environment Canada's Stratospheric Ozone Website:
http://www.ec.gc.ca/ozone

Copies of *CEPA 1999* and *FHR 2003* are available online at:
http://www.ec.gc.ca/ceparegistry/

or contact the BC and Yukon Region representative:

Linda Bily
Environment Canada
401 Burrard Street – suite 201
Vancouver, B.C. V6C 3S5

Phone: (604) 666-2732 ❖ **Fax**: (604) 666-6800 ❖ **Email**: Linda.Bily@ec.gc.ca

Environment Canada Environnement Canada

Canada

What about the BC Provincial Ozone Depleting Substances and other Halocarbons Regulation?

The *BC Ozone Depleting Substances and Other Halocarbons Regulation* (BCODSR) have similar conditions to the *FHR 2003*. The BCODSR was last amended on June 10, 2004 and the changes include new prohibitions against charging CFCs to chillers. The BCODSR is available from the following website:

http://www.qp.gov.bc.ca/statreg/reg/e/envmgmt/387%5F99.htm

or

by calling the BC Ministry of Management Services, Queens Printer at:
(250) 387-3309

For more information about the BCODSR and its amendments, please contact:

Bob Konkin
BC Ministry of Water, Land and Air Protection
PO Box 9342 Stn Prov Govt,
Victoria, BC, V8W 9M1
Phone: (250) 387-9463 ❖ **Fax**: (250) 953-3856 ❖ **Email**: Bob.Konkin@gov.bc.ca

Disclaimer:
This document explains some of the requirements of the *Federal Halocarbon Regulations, 2003* (*FHR 2003*). However, in the event of inconsistencies between this document, the *Canadian Environmental Protection Act, 1999* (*CEPA 1999*), and the *FHR 2003*, *CEPA 1999* and the *FHR 2003* will prevail.

Appendix D

Federal Halocarbon Regulations, 2003 – Information Pertaining to Refrigeration and Air-Conditioning Systems

Environment Canada Environnement Canada

Fact Sheet Federal Halocarbon Regulations, 2003

Information Pertaining to Refrigeration and Air-Conditioning Systems

This fact sheet focuses on the provisions of the *Federal Halocarbon Regulations, 2003* that relate specifically to refrigeration and air-conditioning systems. It is not intended to replace the full legal text of the Regulations or to provide legal opinions. You are advised to retain a lawyer should you require a legal opinion.

A similar fact sheet is also available for fire-extinguishing systems.

Contents

What are halocarbons and why are they regulated?

Halocarbons are synthetic chemical compounds made up of carbon and one or more halogens (chlorine, bromine and fluorine). They are used as refrigerants, fire-extinguishing agents, solvents, foam-blowing agents and fumigants. Common halocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Emissions of halocarbons can lead to ozone layer depletion and contribute to climate change.

Canada

How are halocarbons regulated?

In Canada, the federal, provincial and territorial governments have requirements in place to manage halocarbons. At the federal level, Environment Canada administers two regulations under the *Canadian Environmental Protection Act, 1999*:

- the *Ozone-depleting Substances Regulations, 1998*, which control the import, export, manufacture, use, sale and offer for sale of ozone-depleting substances; and
- the *Federal Halocarbon Regulations, 2003*, which are discussed in this fact sheet.

In addition to federal legislation, each province and territory controls halocarbons in activities that come under its jurisdiction.

Scope of the *Federal Halocarbon Regulations, 2003*

The *Federal Halocarbon Regulations, 2003* replaced the previous *Federal Halocarbon Regulations* on August 13, 2003.

The purpose of the Regulations is to reduce and prevent emissions of halocarbons to the environment from refrigeration, air-conditioning, fire-extinguishing and solvent systems that are

- owned by the federal government (e.g., departments, boards or agencies, Crown corporations) or by federal works or undertakings; or
- located on Aboriginal or federal lands (including all tenants on such lands).

A federal work or undertaking is any work or undertaking that is within the legislative authority of the Parliament of Canada, including but not limited to

- a work or undertaking operated for or in connection with navigation and shipping, whether inland or maritime, including the operation of ships and transportation by ship;
- a railway, canal, telegraph or other work or undertaking connecting one province with another, or extending beyond the limits of a province;
- a line of ships connecting a province with any other province, or extending beyond the limits of a province;
- a ferry between any province and any other province or between any province and any country other than Canada;
- airports, aircraft and commercial air services;
- a broadcast undertaking;
- a bank;
- a work or undertaking that, although wholly situated within a province, is before or after its completion declared by Parliament to be for the general advantage of Canada or for the advantage of two or more provinces (e.g., nuclear facilities, feed mills); and
- a work or undertaking outside the exclusive legislative authority of the legislature of the provinces.

Definitions

Air-conditioning system: an air-conditioning system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant

Certified person: a service technician who holds a certificate recognized by three or more provinces or by the province in which the work is being done, indicating successful completion of an environmental awareness course in recycling, recovery and handling procedures for halocarbon refrigerants as outlined in the Refrigerant Code of Practice

Chiller: an air-conditioning or refrigeration system that has a compressor, an evaporator and a secondary refrigerant

Chiller overhaul: a thorough service activity on a chiller that includes any of the following procedures or repairs:

- replacement or modification of an internal sealing device;
- replacement or modification of an internal mechanical part with the exception of the following parts: oil heater, oil pump, float assembly or, in the case of a chiller with a single-stage compressor, vane assembly; or
- any procedure or repair that resulted from the failure of an evaporator or condenser heat-exchanger tube

Halocarbon: a substance set out in Schedule 1 of the *Federal Halocarbon Regulations, 2003*, whether existing alone or in a mixture, and including isomers of any such substance

Installation: does not include the reactivation of a system by the same owner at the same site

Owner: a person who holds a right in, has possession, control or custody of, is responsible for the maintenance, operation or management of, or has the power to dispose of a system

Purge system: a purge unit on a refrigeration or air-conditioning system, including any associated release recovery equipment

Refrigerant Code of Practice: the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems* published by Environment Canada

Refrigeration system: a refrigeration system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant

Small air-conditioning system: an air-conditioning system that is not contained in a motor vehicle and that has a refrigeration capacity of less than 19 kW as rated by the manufacturer

Small refrigeration system: a refrigeration system that has a refrigeration capacity of less than 19 kW as rated by the manufacturer, other than a system that is installed in, attached to or normally operates in conjunction with a means of transportation

Prohibitions

Prohibited Activities	Exceptions
Releasing a halocarbon from a refrigeration or air-conditioning system or associated container or device	Releasing a halocarbon from a purge system that emits less than 0.1 kg of halocarbon per kg of air purged
Releasing a halocarbon from a container or equipment used in the reuse, recycling, reclamation or storage of that halocarbon	No exceptions
Purchasing, transporting or storing a halocarbon in a container that is not designed and manufactured to be refilled and to contain that specific type of halocarbon	Purchasing, transporting or storing a halocarbon used as a laboratory reagent or analytical standard
Installing a refrigeration or air-conditioning system that operates with a halocarbon other than HCFCs, HFCs or PFCs	No exceptions
Installing or operating a purge system that emits more than 0.1 kg of halocarbon per kg of air purged	No exceptions
Charging a refrigeration or air-conditioning system without it first being leak tested	Charging a leaking system during a period, up to 7 days, that is necessary to prevent an immediate danger to human life or health
Charging a refrigeration or air-conditioning system with a halocarbon other than HCFCs, HFCs or PFCs for leak testing	No exceptions
Charging a refrigeration or air-conditioning system with a halocarbon other than HCFCs, HFCs or PFCs	Charging a chiller that has not undergone an overhaul or a small refrigeration or air-conditioning system
Effective January 1, 2015, operating a chiller that contains a halocarbon other than HCFCs, HFCs or PFCs	No exceptions

Certification

Only a certified person may do work (installing, servicing, leak testing, charging or other work that may result in the release of a halocarbon) on a refrigeration or air-conditioning system.

Servicing, leak testing and decommissioning

Servicing

All work (installing, servicing, leak testing, charging or other work that may result in the release of a halocarbon) on a refrigeration or air-conditioning system must be done in accordance with the Refrigerant Code of Practice.

Before any such work is started, any halocarbon that would otherwise be released during these procedures must be recovered into a container designed and manufactured to be refilled and to contain that specific type of halocarbon.

Once such work is completed, an entry describing the work must be made in a service log containing the information outlined in item 5 of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.

Leak testing

A leak test is required before charging any refrigeration or air-conditioning system, except to charge a system for a period, up to seven days, that is necessary to prevent an immediate danger to human life or health.

Except for small refrigeration and air-conditioning systems and air-conditioning systems designed for occupants in a motor vehicle, leak tests of all system components that come in contact with a halocarbon are also required at least once every 12 months.

Refer to the Refrigerant Code of Practice for more information on acceptable leak testing methods.

As soon as possible after a leak is detected, but not later than seven days, the certified person must notify the owner of the system and the owner must either:

- repair the leak;
- isolate the leaking portion of the system and recover the halocarbon from that portion; or
- recover the halocarbon from the entire system.

A Leak Test Notice containing the information outlined in item 2 of Schedule 2 of the *Federal Halocarbon Regulations, 2003* must be affixed to a system after each leak test. The Notice cannot be removed except to replace it with another notice.

Dismantling, decommissioning and destruction

Prior to dismantling, decommissioning or destroying any refrigeration or air-conditioning system, all halocarbon must be recovered into a container designed and manufactured to be refilled and to contain that specific type of refrigerant.

A Dismantling, Decommissioning and Destruction Notice containing the information outlined in item 1 of Schedule 2 of the *Federal Halocarbon Regulations, 2003* must be affixed to the system. The Notice cannot be removed except to replace it with another notice.

Release reports

Owners must report all halocarbon releases of more than 10 kg to Environment Canada.

In the event of a release of 100 kg or more from a refrigeration or air-conditioning system–or from a container or equipment used in the reuse, recycling, reclamation or storage of the halocarbon–the owner must submit a verbal or written report within 24 hours of detecting the release. The report must indicate the name of the owner, the type of halocarbon released and the type of system, container or equipment from which it was released.

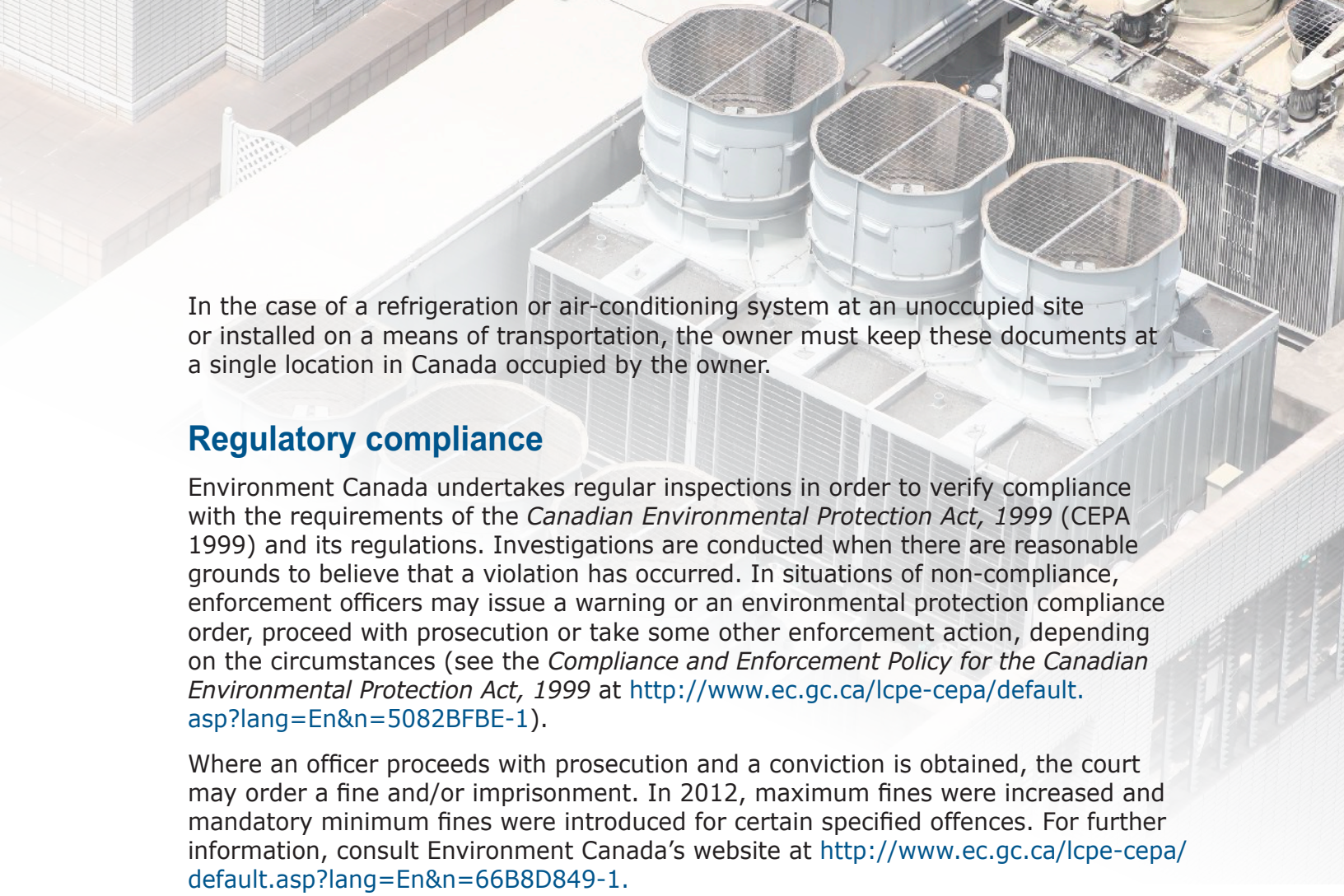
Within 14 days of a release of 100 kg or more, a written report must also be submitted that more fully details the circumstances leading to the release, as well as the corrective and preventative action(s) taken. The information that must be reported is outlined in item 8 of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.

For releases of more than 10 kg but less than 100 kg, the owner must submit no later than January 31 or July 31 a written report containing the information outlined in item 8 of Schedule 2 of the Regulations for all releases in the preceding calendar half-year.

Written reports must be mailed or faxed to the appropriate Environment Canada regional representative (See the **For more information** section).

Record keeping

The owner must keep a copy of all logs, notices, records and reports required by the *Federal Halocarbon Regulations, 2003* at the premises or site where the refrigeration or air-conditioning system is located, for a period of at least five years.



In the case of a refrigeration or air-conditioning system at an unoccupied site or installed on a means of transportation, the owner must keep these documents at a single location in Canada occupied by the owner.

Regulatory compliance

Environment Canada undertakes regular inspections in order to verify compliance with the requirements of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) and its regulations. Investigations are conducted when there are reasonable grounds to believe that a violation has occurred. In situations of non-compliance, enforcement officers may issue a warning or an environmental protection compliance order, proceed with prosecution or take some other enforcement action, depending on the circumstances (see the *Compliance and Enforcement Policy for the Canadian Environmental Protection Act, 1999* at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=5082BFBE-1).

Where an officer proceeds with prosecution and a conviction is obtained, the court may order a fine and/or imprisonment. In 2012, maximum fines were increased and mandatory minimum fines were introduced for certain specified offences. For further information, consult Environment Canada's website at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=66B8D849-1.

For more information

Visit Environment Canada's Stratospheric Ozone website at www.ec.gc.ca/ozone for more information, including information regarding

- Canada's Ozone Layer Protection Program
- the *Federal Halocarbon Regulations, 2003*
- the Refrigerant Code of Practice published by Environment Canada

For additional information, please contact your Environment Canada regional representative listed on the Ozone website.

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Aussi disponible en français

Appendix E

Federal Halocarbon Regulations, 2003 – Information Pertaining to Chillers

Environment Canada Environnement Canada

Fact Sheet Federal Halocarbon Regulations, 2003

Information Pertaining to Chillers

This fact sheet focuses on the prohibition under the *Federal Halocarbon Regulations, 2003* to operate a chiller that contains a prohibited halocarbon after January 1, 2015. It is not intended to replace the full legal text of the Regulations or to provide legal opinions. You are advised to retain a lawyer should you require a legal opinion.

Scope of the *Federal Halocarbon Regulations, 2003*

The *Federal Halocarbon Regulations, 2003* apply to chillers that are:

- owned by the federal government (e.g., departments, boards or agencies, Crown corporations) or by federal works or undertakings; or
- located on Aboriginal or federal lands (including all tenants on such lands).

Definitions

Chiller	an air-conditioning system or refrigeration system that has a compressor, an evaporator and a secondary refrigerant.
Federal work or undertaking	any work or undertaking that is within the legislative authority of the Parliament of Canada, including but not limited to shipping, railways, aviation, broadcasting, banks, or other work or undertaking connecting one province with another. This includes the facilities and any halocarbon-containing systems they may contain.
Owner	a person who holds a right in, has possession, control or custody of, is responsible for the maintenance, operation or management of, or has the power to dispose of, a system.

Canada

Chiller prohibition

The *Federal Halocarbon Regulations, 2003* prohibit operating or permitting to operate any chiller that contains a halocarbon other than HCFCs, HFCs or PFCs after **January 1, 2015**. Any chiller containing a halocarbon other than these three refrigerants must be converted to an alternative refrigerant or be decommissioned by that time. This includes chillers containing CFCs, such as R12, or mixtures containing CFCs, such as R500.

As an owner, you should check your inventory for chillers using a refrigerant that contains a halocarbon listed in any of items 1 to 9 of Schedule 1 of the Regulations (e.g., CFCs) and consider developing a replacement or succession plan to help achieve compliance. This could also help you avoid service disruptions and last-minute costs in meeting the January 1, 2015, prohibition deadline. Your service provider may be able to assist you in this task.

Regulatory compliance

Environment Canada undertakes regular inspections in order to verify compliance with the requirements of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) and its regulations. Investigations are conducted when there are reasonable grounds to believe that an infraction has occurred.

CEPA 1999 provides for penalties up to imprisonment. The enforcement responses are selected based on the principles found in law and framed by the criteria assessment defined in the Compliance and Enforcement Policy for the *Canadian Environmental Protection Act, 1999*.

For more information

Visit Environment Canada's Stratospheric Ozone website at www.ec.gc.ca/ozone for more information, including information regarding

- Canada's Ozone Layer Protection Program
- the *Federal Halocarbon Regulations, 2003*

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For additional information, please contact your Environment Canada regional representative listed on the Ozone website.

Aussi disponible en français

Appendix F

Federal Halocarbon Regulations, 2003 – Information Pertaining to Fire-extinguishing Systems

Environment Canada Environnement Canada

Fact Sheet Federal Halocarbon Regulations, 2003

Information Pertaining to Fire-extinguishing Systems

This fact sheet focuses on the provisions of the *Federal Halocarbon Regulations, 2003* that relate specifically to fire-extinguishing systems. It is not intended to replace the full legal text of the Regulations or to provide legal opinions. You are advised to retain a lawyer should you require a legal opinion.

A similar fact sheet is also available for refrigeration and air-conditioning systems.

Contents

What are halocarbons and why are they regulated?

Halocarbons are synthetic chemical compounds made up of carbon and one or more halogens (chlorine, bromine and fluorine). They are used as refrigerants, fire-extinguishing agents, solvents, foam-blowing agents and fumigants. Common halocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Emissions of halocarbons can lead to ozone layer depletion and contribute to climate change.

Canada

How are halocarbons regulated?

In Canada, the federal, provincial and territorial governments have requirements in place to manage halocarbons. At the federal level, Environment Canada administers two regulations under the *Canadian Environmental Protection Act, 1999*:

- the *Ozone-depleting Substances Regulations, 1998*, which control the import, export, manufacture, use, sale and offer for sale of ozone-depleting substances; and
- the *Federal Halocarbon Regulations, 2003*, which are discussed in this fact sheet.

In addition to federal legislation, each province and territory controls halocarbons in activities that come under its jurisdiction.

Scope of the *Federal Halocarbon Regulations, 2003*

The *Federal Halocarbon Regulations, 2003* replaced the previous *Federal Halocarbon Regulations* on August 13, 2003.

The purpose of the Regulations is to reduce and prevent emissions of halocarbons to the environment from refrigeration, air-conditioning, fire-extinguishing and solvent systems that are

- owned by the federal government (e.g., departments, boards or agencies, Crown corporations) or by federal works or undertakings; or
- located on Aboriginal or federal lands (including all tenants on such lands).

A federal work or undertaking is any work or undertaking that is within the legislative authority of the Parliament of Canada, including but not limited to

- a work or undertaking operated for or in connection with navigation and shipping, whether inland or maritime, including the operation of ships and transportation by ship;
- a railway, canal, telegraph or other work or undertaking connecting one province with another, or extending beyond the limits of a province;
- a line of ships connecting a province with any other province, or extending beyond the limits of a province;
- a ferry between any province and any other province or between any province and any country other than Canada;
- airports, aircraft and commercial air services;
- a broadcast undertaking;
- a bank;
- a work or undertaking that, although wholly situated within a province, is before or after its completion declared by Parliament to be for the general advantage of Canada or for the advantage of two or more provinces (e.g., nuclear facilities, feed mills); and
- a work or undertaking outside the exclusive legislative authority of the legislature of the provinces.

Definitions

Fire-extinguishing system:
fire-extinguishing equipment, including portable or fixed equipment and any associated equipment, that contains or is designed to contain a halocarbon fire-extinguishing agent

Halocarbon:
a substance set out in Schedule 1 of the *Federal Halocarbon Regulations, 2003*, whether existing alone or in a mixture, and including isomers of any such substance

Installation:
does not include the reactivation of a system by the same owner at the same site

Military vehicle:
a vehicle that is designed to be used in combat, or in a combat support role, but does not include an administrative vehicle

Owner:
a person who holds a right in, has possession, control or custody of, is responsible for the maintenance, operation or management of, or has the power to dispose of a system

Portable fire extinguisher:
a cylinder or cartridge containing a halocarbon that is used for extinguishing fires, that has a charging capacity of 25 kg or less and that can be carried or wheeled to the site of a fire

Prohibitions

Prohibited Activities	Exceptions
Releasing a halocarbon from a fire-extinguishing system or associated container or device	Releasing a halocarbon: • to fight a fire that is not set for training purposes, or • during the recovery of halocarbons into an appropriate container and using recovery equipment operating at a transfer efficiency of at least 99% as referred to in the publication *Halon and Halocarbon Clean Agent Recovery and Reconditioning Equipment* (ULC/ORD-C1058.5-2004)
Releasing a halocarbon from a container or equipment used in the reuse, recycling, reclamation or storage of that halocarbon	No exceptions

Prohibited Activities	Exceptions
Purchasing, transporting or storing a halocarbon in a container that is not designed and manufactured to be refilled and to contain that specific type of halocarbon	Purchasing, transporting or storing a halocarbon used as a laboratory reagent or analytical standard
Installing a fire-extinguishing system that operates with a halocarbon other than HCFCs, HFCs or PFCs	Installing a system when it is authorized by a permit granted under the *Federal Halocarbon Regulations, 2003*
Charging a fire-extinguishing system without it first being leak tested	Charging a leaking system during a period, up to 7 days, that is necessary to prevent an immediate danger to human life or health
Charging a fire-extinguishing system with a halocarbon other than HCFCs, HFCs or PFCs for leak testing	No exceptions
Charging a portable fire extinguisher with a halocarbon other than HCFCs, HFCs or PFCs	Charging a portable fire extinguisher for use on an aircraft, military ship or military vehicle or when authorized by a permit granted under the *Federal Halocarbon Regulations, 2003*
Charging a fire-extinguishing system with a halocarbon other than HCFCs, HFCs or PFCs	Charging a portable fire extinguisher or a fire-extinguishing system for use on an aircraft, military ship or military vehicle or when authorized by a permit granted under the *Federal Halocarbon Regulations, 2003*

Servicing, leak testing and decommissioning

Servicing

All work (installing, servicing, leak testing, charging or other work that may result in the release of a halocarbon) on a fire-extinguishing system must be done in accordance with the publication *The Servicing of Halon and Clean Agent Extinguishing Systems* (ULC/ORD-C1058.18-2004).

Before any such work is started, the halocarbon must be recovered into a container designed and manufactured to be refilled and to contain that specific type of halocarbon. The recovery must be completed using recovery equipment with a transfer efficiency of at least 99% in accordance with the

publication *Halon and Halocarbon Clean Agent Recovery and Reconditioning Equipment* (ULC/ORD-C1058.5-2004).

Once such work is completed, an entry describing the work must be made in a service log containing the information outlined in item 6 of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.

In addition, fire-extinguishing systems other than portable fire extinguishers must not be serviced until the owner is notified and a notice is affixed to the control panel indicating that the system is out of operation.

Leak testing

A leak test is required before charging any fire-extinguishing system except to charge a system for a period, up to seven days, that is necessary to prevent an immediate danger to human life or health.

Except for portable fire extinguishers and fire-extinguishing systems whose cylinder or cartridge has a charging capacity of 10 kg or less and are which located in military vehicles, military ships or military aircraft, leak tests of all system components that come in contact with a halocarbon are also required at least once every 12 months.

As soon as possible after a leak is detected but not later than seven days, the technician must notify the owner of the system and the owner must either

- repair the leak;
- isolate the leaking portion of the system and recover the halocarbon from that portion; or
- recover the halocarbon from the entire system.

Dismantling, decommissioning and destruction

Prior to dismantling, decommissioning or destroying any fire-extinguishing system, all halocarbon must be recovered into a container designed and manufactured to be refilled and to contain that specific type of halocarbon.

A Dismantling, Decommissioning and Destruction Notice containing the information outlined in item 1 of Schedule 2 of the *Federal Halocarbon Regulations, 2003* must be affixed to the system. The Notice cannot be removed except to replace it with another notice.

Release reports

Owners must report all halocarbon releases of more than 10 kg to Environment Canada.

In the event of a release of 100 kg or more from a fire-extinguishing system–or from a container or equipment used in the reuse, recycling, reclamation or storage of the halocarbon–the owner must submit a verbal or written report within 24 hours of detecting the release. The report must indicate the name of the owner, the type of halocarbon released and the type of system, container or equipment from which it was released.

Within 14 days of a release of 100 kg or more, a written report must also be submitted that more fully details the circumstances leading to the release, as well as the corrective and preventative action(s) taken. The information that must be reported is outlined in item 8 of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.

For releases of more than 10 kg but less than 100 kg, the owner must submit no later than January 31 or July 31 a written report containing the information outlined in item 8 of Schedule 2 of the Regulations for all releases in the preceding calendar half-year.

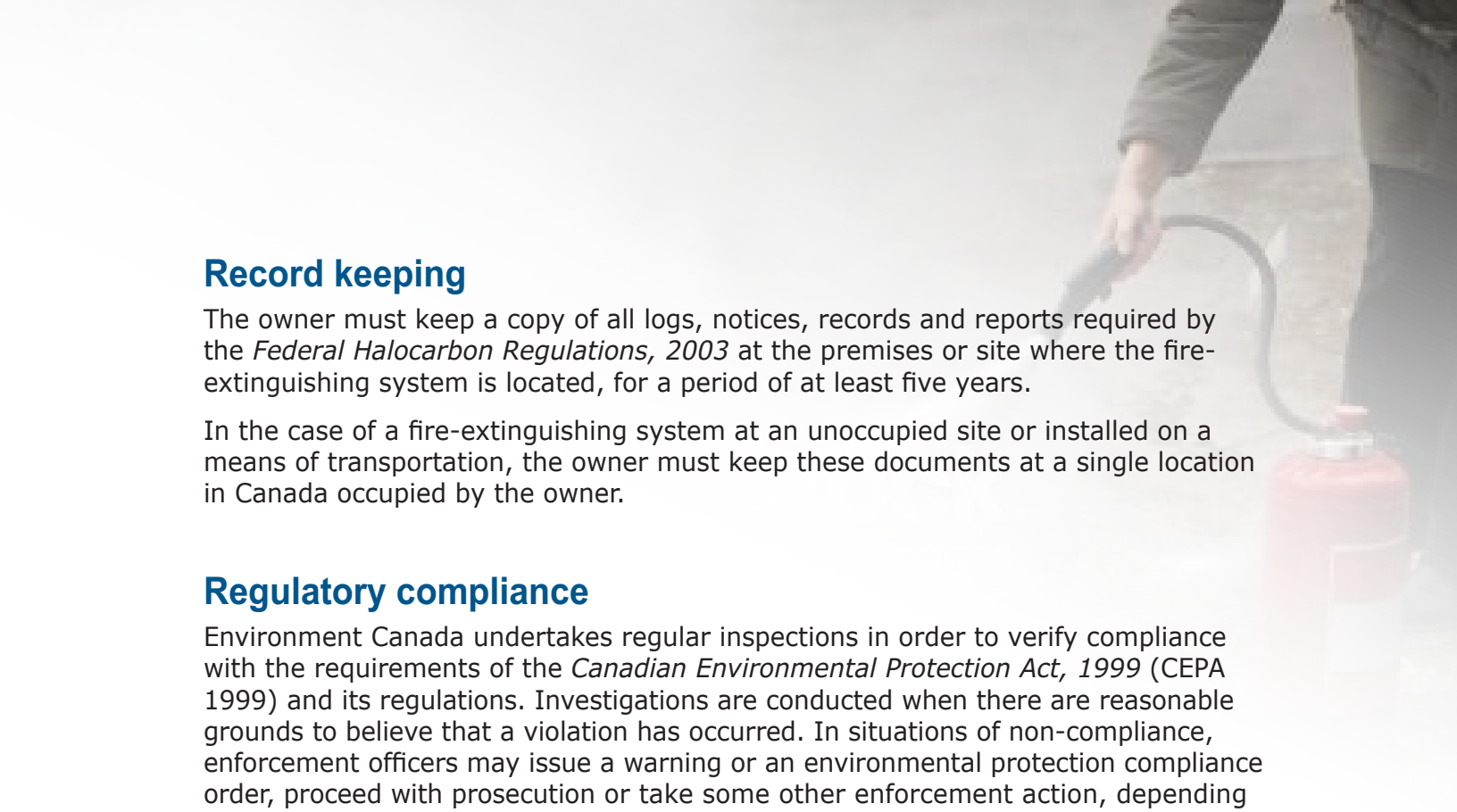
Written reports must be mailed or faxed to the appropriate Environment Canada regional representative (See the **For more information** section).

Permits

Permits may be issued for installing or charging a fire-extinguishing system with a halocarbon other than HCFCs, HFCs or PFCs as an extinguishing agent. Permits may be granted when there is no technically and financially feasible alternative that could have a less harmful impact on the environment and on health.

Permits are valid for one year beginning on the date of issuance. The Minister of the Environment may cancel a permit if it has been determined that false or misleading information was provided in support of the permit application.

Requests for a permit to install a fire-extinguishing system or charge a portable fire-extinguishing system must contain the information outlined in item 10 or 11, as the case may be, of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.



Record keeping

The owner must keep a copy of all logs, notices, records and reports required by the *Federal Halocarbon Regulations, 2003* at the premises or site where the fire-extinguishing system is located, for a period of at least five years.

In the case of a fire-extinguishing system at an unoccupied site or installed on a means of transportation, the owner must keep these documents at a single location in Canada occupied by the owner.

Regulatory compliance

Environment Canada undertakes regular inspections in order to verify compliance with the requirements of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) and its regulations. Investigations are conducted when there are reasonable grounds to believe that a violation has occurred. In situations of non-compliance, enforcement officers may issue a warning or an environmental protection compliance order, proceed with prosecution or take some other enforcement action, depending on the circumstances (see the *Compliance and Enforcement Policy for the Canadian Environmental Protection Act, 1999* at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=5082BFBE-1).

Where an officer proceeds with prosecution and a conviction is obtained, the court may order a fine and/or imprisonment. In 2012, maximum fines were increased and mandatory minimum fines were introduced for certain specified offences. For further information, consult Environment Canada's website at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=66B8D849-1.

For more information

Visit Environment Canada's Stratospheric Ozone website at www.ec.gc.ca/ozone for more information, including information regarding

- Canada's Ozone Layer Protection Program
- the *Federal Halocarbon Regulations, 2003*

For additional information, please contact your Environment Canada regional representative listed on the Ozone website.

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Aussi disponible en français

Appendix G

Federal Halocarbon Regulations, 2003 – Information For Services Contractors Pertaining to Refrigeration and Air-Conditioning Systems

Environment Canada Environnement Canada

Fact Sheet Federal Halocarbon Regulations, 2003

Information for Service Contractors Pertaining to Refrigeration and Air-Conditioning Systems

This fact sheet focuses on the provisions of the Federal Halocarbon Regulations, 2003 that relate specifically to service contractors for refrigeration and air-conditioning systems. It is not intended to replace the full legal text of the Regulations or to provide legal opinions. You are advised to retain a lawyer should you require a legal opinion.

Contents

What are halocarbons and why are they regulated?

Halocarbons are synthetic chemical compounds made up of carbon and one or more halogens (chlorine, bromine and fluorine). Common halocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Emissions of halocarbons can lead to ozone layer depletion and contribute to climate change.

Canada

How are halocarbons regulated?

In Canada, the federal, provincial and territorial governments have requirements in place to manage halocarbons. At the federal level, Environment Canada administers two regulations under the *Canadian Environmental Protection Act, 1999*:

- the *Ozone-depleting Substances Regulations, 1998*, which control the import, export, manufacture, use, sale and offer for sale of ozone-depleting substances; and
- the *Federal Halocarbon Regulations, 2003*, which are discussed in this fact sheet.

In addition to federal legislation, each province and territory controls halocarbons in activities that come under its jurisdiction.

Do the *Federal Halocarbon Regulations, 2003* apply to me?

The *Federal Halocarbon Regulations, 2003* apply to you if you are a service technician or mechanic working on a refrigeration or air-conditioning system that is

- owned by the federal government (e.g., departments, boards or agencies, Crown corporations) or by federal works or undertakings; or
- located on Aboriginal or federal lands (including all tenants on such lands).

What are federal works and undertakings?

A federal work or undertaking is any work or undertaking that is within the legislative authority of the Parliament of Canada, including but not limited to

- a work or undertaking operated for or in connection with navigation and shipping, whether inland or maritime, including the operation of ships and transportation by ship;
- a railway, canal, telegraph or other work or undertaking connecting one province with another, or extending beyond the limits of a province;
- a line of ships connecting a province with any other province, or extending beyond the limits of a province;
- a ferry between any province and any other province or between any province and any country other than Canada;
- airports, aircraft and commercial air services;
- a broadcast undertaking;
- a bank;
- a work or undertaking that, although wholly situated within a province, is before or after its completion declared by Parliament to be for the general advantage of Canada or for the advantage of two or more provinces (e.g., nuclear facilities, feed mills); and
- a work or undertaking outside the exclusive legislative authority of the legislature of the provinces.

Definitions

Air-conditioning system: an air-conditioning system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant

Certified person: a service technician who holds a certificate recognized by three or more provinces or by the province in which the work is being done, indicating successful completion of an environmental awareness course in recycling, recovery and handling procedures for halocarbon refrigerants as outlined in the Refrigerant Code of Practice

Chiller: an air-conditioning or refrigeration system that has a compressor, an evaporator and a secondary refrigerant

Chiller overhaul: a thorough service activity on a chiller that includes any of the following procedures or repairs:

- replacement or modification of an internal sealing device;
- replacement or modification of an internal mechanical part with the exception of the following parts: oil heater, oil pump, float assembly or, in the case of a chiller with a single-stage compressor, vane assembly; or
- any procedure or repair that resulted from the failure of an evaporator or condenser heat-exchanger tube

Halocarbon: a substance set out in Schedule 1 of the *Federal Halocarbon Regulations, 2003*, whether existing alone or in a mixture, and including isomers of any such substance

Installation: does not include the reactivation of a system by the same owner at the same site

Owner: a person who holds a right in, has possession, control or custody of, is responsible for the maintenance, operation or management of, or has the power to dispose of a system

Purge system: a purge unit on a refrigeration or air-conditioning system, including any associated release recovery equipment

Refrigerant Code of Practice: the *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air-Conditioning Systems* published by Environment Canada

Refrigeration system: a refrigeration system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant

Small air-conditioning system: an air-conditioning system that is not contained in a motor vehicle and that has a refrigeration capacity of less than 19 kW as rated by the manufacturer

Small refrigeration system: a refrigeration system that has a refrigeration capacity of less than 19 kW as rated by the manufacturer, other than a system that is installed in, attached to or normally operates in conjunction with a means of transportation

What is prohibited?

Prohibited Activities	Exceptions
Releasing a halocarbon from a refrigeration or air-conditioning system or associated container or device	Releasing a halocarbon from a purge system that emits less than 0.1 kg of halocarbon per kg of air purged
Releasing a halocarbon from a container or equipment used in the reuse, recycling, reclamation or storage of that halocarbon	No exceptions
Purchasing, transporting or storing a halocarbon in a container that is not designed and manufactured to be refilled and to contain that specific type of halocarbon	Purchasing, transporting or storing a halocarbon used as a laboratory reagent or analytical standard
Installing a refrigeration or air-conditioning system that operates with a halocarbon other than HCFCs, HFCs or PFCs	No exceptions
Installing or operating a purge system that emits more than 0.1 kg of halocarbon per kg of air purged	No exceptions
Charging a refrigeration or air-conditioning system without it first being leak tested	Charging a leaking system during a period, up to 7 days, that is necessary to prevent an immediate danger to human life or health
Charging a refrigeration or air-conditioning system with a halocarbon other than HCFCs, HFCs or PFCs for leak testing	No exceptions
Charging a refrigeration or air-conditioning system with a halocarbon other than HCFCs, HFCs or PFCs	Charging a chiller that has not undergone an overhaul or a small refrigeration or air-conditioning system
Effective January 1, 2015, operating a chiller that contains a halocarbon other than HCFCs, HFCs or PFCs	No exceptions

What else do I need to know?

Servicing

Only a certified person may do work (installing, servicing, leak testing, charging or other work that may result in the release of a halocarbon) on a refrigeration or air-conditioning system.

All such work must be done in accordance with the Refrigerant Code of Practice.

Before any such work is started, any halocarbon that would otherwise be released during these procedures must be recovered into a container designed and manufactured to be refilled and to contain that specific type of halocarbon.

Once such work is completed, an entry describing the work must be made in a service log containing the information outlined in item 5 of Schedule 2 of the *Federal Halocarbon Regulations, 2003*.

Leak testing

A leak test is required before charging any refrigeration or air-conditioning system, except to charge a system for a period, up to seven days, that is necessary to prevent an immediate danger to human life or health.

Except for small refrigeration and air-conditioning systems and air-conditioning systems designed for occupants in a motor vehicle, leak tests of all system components that come in contact with a halocarbon are also required at least once every 12 months.

Refer to the Refrigerant Code of Practice for more information on acceptable leak testing methods.

A Leak Test Notice containing the information outlined in item 2 of Schedule 2 of the *Federal Halocarbon Regulations, 2003* must be affixed to a system after each leak test. The Notice cannot be removed except to replace it with another notice.

Dismantling, decommissioning and destruction

Prior to dismantling, decommissioning or destroying any refrigeration or air-conditioning system, all halocarbon must be recovered into a container designed and manufactured to be refilled and to contain that specific type of refrigerant.

A Dismantling, Decommissioning and Destruction Notice containing the information outlined in item 1 of Schedule 2 of the *Federal Halocarbon Regulations, 2003* must be affixed to the system. The Notice cannot be removed except to replace it with another notice.

Regulatory compliance

Environment Canada undertakes regular inspections in order to verify compliance with the requirements of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) and its regulations. Investigations are conducted when there are reasonable grounds to believe that a violation has occurred. In situations of non-compliance, enforcement officers may issue a warning or an environmental protection compliance order, proceed with prosecution or take some other enforcement action, depending on the circumstances (see the *Compliance and Enforcement Policy for the Canadian Environmental Protection Act, 1999* at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=5082BFBE-1).

Where an officer proceeds with prosecution and a conviction is obtained, the court may order a fine and/or imprisonment. In 2012, maximum fines were increased and mandatory minimum fines were introduced for certain specified offences. For further information, consult Environment Canada's website at http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=66B8D849-1.

For more information

Visit Environment Canada's Stratospheric Ozone website at www.ec.gc.ca/ozone for more information, including information regarding

- Canada's Ozone Layer Protection Program
- the *Federal Halocarbon Regulations, 2003*
- the Refrigerant Code of Practice published by Environment Canada

For additional information, please contact your Environment Canada regional representative listed on the Ozone website.

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Aussi disponible en français

Appendix H

Fact Sheet on Halons in Fire-Extinguishing Systems: Phase-out and Disposal

Government of Canada / Gouvernement du Canada

Fact sheet on halons in fire-extinguishing systems: phase-out and disposal

Content

This fact sheet aims to inform owners of halon fire-extinguishing systems and personnel servicing these systems of the phase-out requirements and disposal options for these systems in Canada.

Controls on Manufacture, Import and Export of Halons

The federal Ozone-depleting Substances Regulations, 1998 (ODSR 1998) regulate the manufacture, import and export of ozone-depleting substances (ODS), including halons, in Canada. With respect to halons, the

ODSR (Ozone-depleting Substances Regulations) 1998 reaches its objective of reducing the production and consumption of ODS (Ozone-depleting substances) by:

- banning the manufacture, import and export of bulk new halon
- not allowing the import, for use in Canada, of bulk used, recovered, recycled, or reclaimed halon
- not allowing the export of halons to another country except for essential purposes, reclamation or destruction
- prohibiting the manufacture and import of products that contain or are designed to contain halons (such as fire-extinguishing systems) except for use in aircraft, military ships or military vehicles

The ODSR (Ozone-depleting Substances Regulations) 1998 allows for some exceptions to the first three prohibitions described above, however only if authorized under a permit issued by Environment Canada. Further information on these exceptions, the permitting process, and importing and exporting halons and halon-containing products may be obtained by contacting Environment Canada's Ozone Protection Programs (contact information is found below, under Further Information).

Controls on Use and Handling of Halons

In addition to being ozone-depleting substances, halons are greenhouse gases. In order to reduce and prevent emissions of halons in Canada, the use and handling of halons are regulated by the provinces/territories in their respective jurisdictions, and through the Federal Halocarbon Regulations, 2003 (FHR 2003) for systems under federal jurisdiction. **If a halon fire-extinguishing system is not subject to the FHR (Federal**

Halocarbon Regulations) 2003, it falls under provincial/territorial jurisdiction and is subject to the applicable provincial or territorial regulations.

- **Important note for fire-extinguishing systems regulated under the FHR (Federal Halocarbon Regulations) 2003:**

  The Federal Halocarbon Regulations 1999, which preceded the FHR (Federal Halocarbon Regulations) 2003, prohibited the installation of halon fire-extinguishing systems, unless authorized to do so by a permit issued by Environment Canada. The FHR (Federal Halocarbon Regulations) 2003 include a similar prohibition. Halon fire-extinguishing systems that were installed before these prohibitions were put in place can continue to operate, however there are restrictions on recharging these systems:

  - **Portable systems:** It is prohibited to charge a portable system with halon, except for use on an aircraft, military vehicle or military ship, or unless authorized to do so by a permit issued under the FHR (Federal Halocarbon Regulations) 2003.

  - **Non-portable (i.e. fixed) systems:**After December 31st, 2009, the one-time charging allowance provided for in s.30 of the FHR (Federal Halocarbon Regulations) 2003 for fixed systems no longer applies, and therefore a fixed system cannot be charged with halon, except for use on aircraft, military vehicle or military ship, or unless authorized to do so by a permit under the FHR (Federal Halocarbon Regulations) 2003.

For information regarding requirements for fire-extinguishing systems under the federal jurisdiction, contact Environment Canada's Ozone Protection Programs (contact information is found below, under Further Information).

View full text of consolidated Federal Halocarbon Regulations, 2003 in HTML or View full text of consolidated Federal Halocarbon Regulations, 2003 in PDF

- **Fire-extinguishing systems regulated under the provinces/territories:**

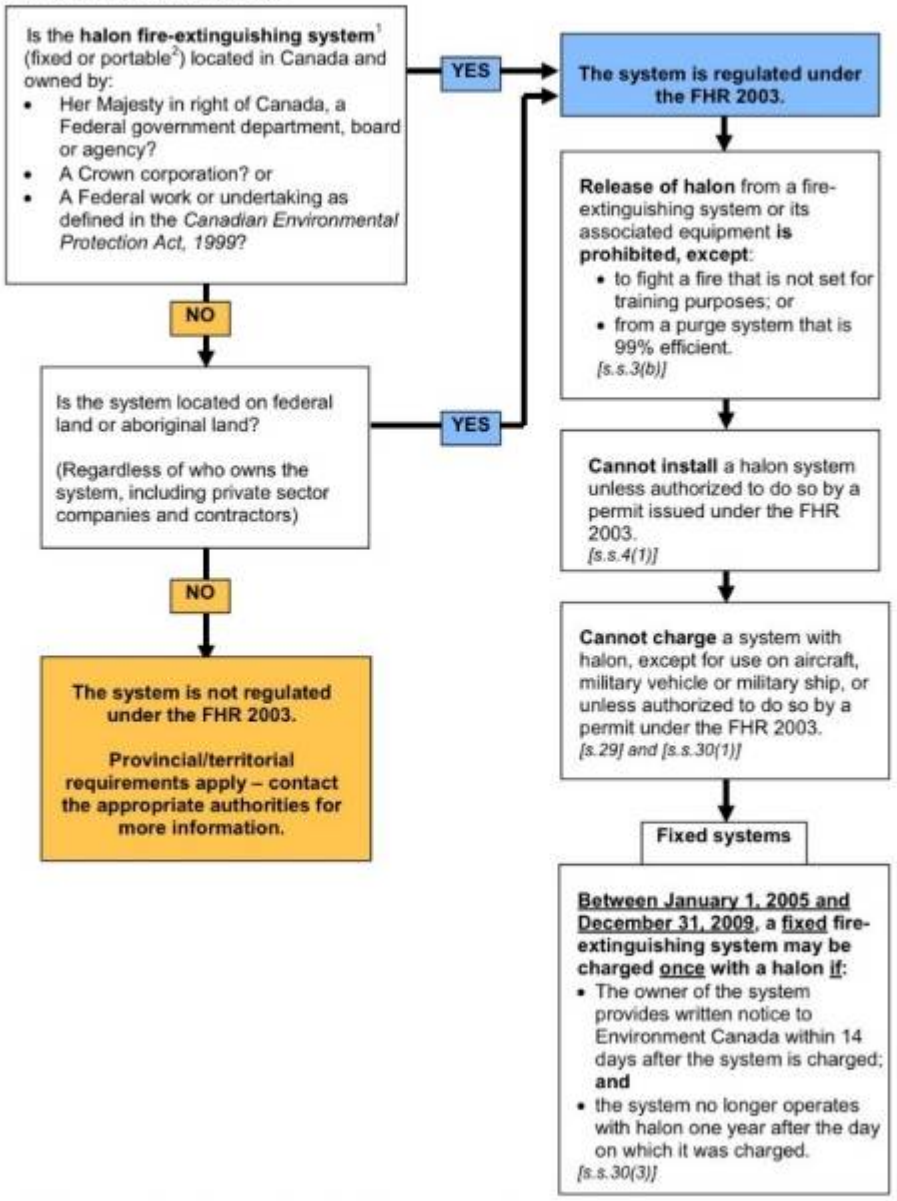
  Provincial/territorial requirements may differ from those prescribed in the FHR (Federal Halocarbon Regulations) 2003.

  For information regarding requirements for systems under provincial or territorial jurisdiction, please contact the appropriate authority in your region (contact information is found below, under Further Information).

  Links to Provincial and Territorial Acts and Regulations on halocarbons

The following chart will help you determine what provisions regarding phase-out of halons apply to your halon fire-extinguishing system(s) (section nos. refer to the applicable FHR (Federal Halocarbon Regulations) 2003 provisions):

The following chart will help you determine what provisions regarding phase-out of halons apply to your halon fire-extinguishing system(s) (*section nos. refer to the applicable FHR 2003 provisions*):



1. A fire-extinguishing system means fire-extinguishing equipment, including portable or fixed equipment and any associated equipment, that contains or is designed to contain a halocarbon fire-extinguishing agent.
2. A portable fire extinguisher is a cylinder or cartridge that has a charging capacity of 25 kg or less and that can be carried or wheeled to the site of a fire.

Page 3 of 7

Requirements for Decommissioning Halon Fire-Extinguishing Systems and Recovery of Halons

Halons must be properly recovered from decommissioned systems to prevent releases

Extreme care must be taken when decommissioning a halon fire-extinguishing system to prevent releases. Before a system is decommissioned, dismantled or destroyed, the halon must be recovered in accordance with the standard Halocarbon Clean Agent Recovery and Reconditioning Equipment (ULC (Underwriters Laboratories of Canada)/ORD-C1058.5-2004). Additionally, work performed on halon fire-extinguishing systems must be done according to the standard The Servicing of Halon and Clean Agent Extinguishing Systems (ULC (Underwriters Laboratories of Canada)/ORD-C1058.18-2004).

The FHR (Federal Halocarbon Regulations) 2003 requires that halons be recovered, stored and transported in containers designed and manufactured to be refilled and to contain that specific type of halon. If halons are stored, they must be contained in appropriate containers that are stored in a dry, clean environment to prevent corrosion. It is strongly recommended that storage containers be visually inspected regularly, as an additional measure to prevent releases. Containers must be stored in compliance with applicable occupational health and safety regulations and fire and building codes. Storing unwanted halons is not advised. Refer to the next section for disposal options.

Be advised that additional requirements concerning transportation and shipping of surplus halons may apply, including but not limited to the Transportation of Dangerous Goods Regulations. Halons designated as hazardous waste are subject to further shipping requirements. It is highly recommended that Transport Canada's Transport Dangerous Goods Directorate be contacted, as well as the applicable provincial and territorial authorities (see Further Information, below), prior to shipping surplus halons.

Guidance on Disposal of Halons

Disposal options in Canada

Halon-containing fire-extinguishing systems must be properly disposed of at the end of their useful life. Proper disposal means having the system decommissioned and any halon recovered by a technician operating in accordance with ULC (Underwriters Laboratories of Canada) standards C1058.18-2004 and C1058.5-2004. Halon recovered from decommissioned systems is typically either:

- Recycled or reclaimed for use in Canada in existing fire-extinguishing systems that are exempt from the charging prohibition (aircraft, military vehicles and military ships)
- Exported to the United States for destruction; or
- Exported to the United States for halon banking, which assists sellers wishing to dispose of halon in a responsible manner, and helps buyers with "critical uses" locate supplies of Halon 1301 and Halon 1211 for recharging their existing systems. For information on halon banking in the US (United States), contact the US (United States) Environmental Protection Agency (US EPA) Stratospheric Ozone Information Hotline at 1-800-296-1996.

Halon fire-extinguishing service companies or halon recovery/recycling operations certified to ULC (Underwriters Laboratories of Canada) standards can assist in determining available disposal options, mentioned above. For information on ULC (Underwriters Laboratories of Canada) certified companies in your area please contact the Underwriters Laboratories of Canada (ULC).

Note: A permit to export the halons to the United States is required under the federal Ozone-depleting Substances Regulations, 1998. Please contact Environment Canada’s Ozone Protection Programs for a permit application

form. Export of halons may also be subject to other federal and/or provincial regulations related to hazardous waste management.

Alternatives to halon fire-extinguishing agents

Alternative agents and technologies for halon fire-extinguishing systems are available for most applications. When choosing an alternative, one should consider suitability, other applicable Canadian legislation on fire protection, as well as the environmental risks involved, including the ozone-depleting potential and the global warming potential of the fire-extinguishing agent. Environment Canada does not approve or prescribe alternatives to halons. Please contact the applicable provincial or territorial fire code authorities to learn more about how these fire codes apply to halon-alternative fire-extinguishing agents and technologies. A list of these authorities is available at the ULC (Underwriters Laboratories of Canada) website.

Additionally, the United States Environmental Protection Agency website provides a list containing information on some alternatives that exist on the market.

Note: Fire-extinguishing systems containing halocarbon alternatives to halons, namely HCFCs (Hydrochlorofluorocarbons) and HFCs (Hydrofluorocarbons), are regulated under the provincial/territorial ODS (Ozone-depleting substances) and halocarbon regulations in their respective jurisdictions, and through the Federal Halocarbon Regulations, 2003 (FHR 2003) for systems under federal jurisdiction.

Further Information

Requests for further information on the ODSR (Ozone-depleting Substances Regulations) 1998 and FHR (Federal Halocarbon Regulations) 2003 can be forwarded to:

Ozone Layer Protection and Export Controls
Chemical Production Division
Environment Canada
351 St. Joseph Blvd., 11th floor
Gatineau, Quebec K1A 0H3
Tel.: 819-938-4228
Fax: 819-938-4218
Email: ec.gestionhalocarbures-halocarbonsmanagement.ec@canada.ca

or please visit Environment Canada's Stratospheric Ozone website.

Viewfull text of consolidated Ozone-depleting Substances Regulations, 1998 (PDF)
View full text of consolidated Federal Halocarbon Regulations, 2003 (PDF)

Links to Provincial and Territorial Acts and Regulations on halocarbons
(page also provides contacts for Provincial and Territorial authorities)

Date modified:
2016-04-11

Appendix I

Halocarbon System Cooling Thresholds That Trigger Additional Regulatory Requirements

Fisheries and Oceans Canada | Pêches et Océans Canada

ROEC, 2019

Environmental Compliance

Regional Office of Environmental Coordination

Halocarbon System Cooling Thresholds

that trigger additional regulatory requirements

Project managers are responsible for the installation of halocarbon-containing systems that are federally-owned and/or located on federal land and must inform contractors of their obligation to the *Federal Halocarbon Regulations (2003)*.

Under the Federal Halocarbon Regulations, **Large Installed Systems** are those that have a **refrigeration output capacity**, or cooling capacity, of **greater than 19 kW** as rated by the manufacturer.

Refrigeration Output (Cooling Capacity) Conversion
19 kiloWatts (kW) is equivalent to:
65000 *BTU/hr*
5.4 *Tons*
25.7 *Horse Power*
190000 *Volt Amperes*

Servicing events on Large Installed Systems must be completed by an appropriately Certified Technician and the events must be documented/recorded.

A requirement for annual leak-tests exists for halocarbon-containing systems with refrigeration (cooling) capacities exceeding 19kW; please inform the site manager and notify ROEC if installing systems of this size

Need more information?

Contact
ROECpacific@dfo-mpo.gc.ca

Read
the Halocarbon Management Procedure

Canada

Appendix J

Decommissioning & Disposal of Hydrocarbon Containing Systems

Environmental Compliance

Regional Office of Environmental Coordination

Decommissioning & Disposal *of* Halocarbon-containing Systems

Project managers are responsible for the decommissioning & disposal of halocarbon-containing systems that are **federally owned** and/or **located on federal land** and must inform contractors of their obligation to the *Federal Halocarbon Regulations (2003)*.

Halocarbons are environmentally destructive and must be recovered from halocarbon systems by a **certified** technician prior to disposal.

Halocarbons may be found in:

- Fire suppression & extinguishing systems
- Commercial or residential fridges & freezers
- Compressors, chillers, heat pumps
- Air conditioning systems
- Laboratory equipment
- Water coolers
- Solvent systems

Decommissioning and disposal events must be documented by the contractor in both the blue Halocarbon Service Log Book and on the Disposal or Decommissioning Notice, to be given to the site manager

If a halocarbon release occurs or is identified during decommissioning, both the site manager and ROEC must be notified .

Decommissioning must be performed by a "certified" contractor who holds *Refrigeration Code of Practice (Environmental Awareness in ODS)* and trade qualification certificates. Contractors must also review the *Federal Halocarbon Regulations* **Contractor Awareness Document** found in the Halocarbon Management Procedure issued by ROEC.

Need more information?

Contact
ROECpacific@dfo-mpo.gc.ca

Read
the Halocarbon Management Procedure

Environmental Compliance

Regional Office of Environmental Coordination

a Compliant Decommissioning & Disposal Process for Project Managers

1. Procure a "certified" contractor to recover the halocarbons → 2. Ensure contractor compliance to federal requirements → 3. Have your contractor document the decommissioning or disposal

Only a "certified person" may service halocarbon-containing equipment.	A copy of the Contractor Awareness Document, found in the Halocarbon Management Procedure, must be provided to your contractor prior to service.	Written records must be retained on-site for at least 5 years. A disposal or decommissioning notice must be affixed to equipment.
Confirm your contractor has the following required certifications: **1.** Trade Qualification Certificate **2.** Refrigeration Code of Practice (Environmental Awareness in Ozone Depleting Substances) Certificate	In the contractor's Scope of Work, include condition of compliance to the *Federal Halocarbon Regulations* in addition to the ROEC-issued Halocarbon Management Procedure.	Ensure your contractor fully completes the following: **1.** All forms found in the site's blue Service Log Book **2.** Disposal or Decommissioning Notice.
	Regulatory Requirements	Project Manager Actions

Appendix K

Installation Requirements for Halocarbon Containing Systems

ROEC, 2018

Environmental Compliance

Regional Office of Environmental Coordination

Installation Requirements *for* Halocarbon-containing Systems

Project managers are responsible for the installation of halocarbon-containing systems that are **federally-owned** and/or **located on federal land** and must inform contractors of their obligation to the *Federal Halocarbon Regulations (2003)*.

All service events, including **installations**, must be performed by a **"certified"** contractor who holds *Refrigeration Code of Practice (Environmental Awareness in ODS)* and trade qualification certificates. Contractors must also review the *Federal Halocarbon Regulations* **Contractor Awareness Document** found in the Halocarbon Management Procedure issued by ROEC. Installations must be documented by the contractor in the site's blue Halocarbon Service Log Book.

If a **halocarbon release** occurs during an installation, both the site manager and ROEC must be notified.

A requirement for **annual leak-tests** exists for halocarbon-containing systems with refrigeration (cooling) capacities **exceeding 19kW**; please inform the site manager and notify ROEC if installing systems of this size

Halocarbons are environmentally destructive compounds often used as refrigerants.

Halocarbons may be found in:

- Fire suppression & extinguishing systems
- Commercial or residential fridges & freezers
- Compressors, chillers, heat pumps
- Air conditioning systems
- Laboratory equipment
- Water coolers
- Solvent systems

Need more information?

Contact
ROECpacific@dfo-mpo.gc.ca

Read
the Halocarbon Management Procedure

Environmental Compliance

Regional Office of Environmental Coordination

a Compliant Installation Process *for* Project Managers

1. Procure a "certified" contractor → 2. Ensure contractor compliance to federal requirements → 3. Have your contractor document the installation

Regulatory Requirements

Only a "certified person" may install halocarbon-containing equipment.

A copy of the Contractor Awareness Document, found in the Halocarbon Management Procedure, must be provided to your contractor prior to installation.

Written records must be retained on-site for at least 5 years. Service logs must be affixed to equipment.

Project Manager Actions

Confirm your contractor has the following required certifications:

1. Trade Qualification Certificate
2. Refrigeration Code of Practice (Environmental Awareness in Ozone Depleting Substances) Certificate

In the contractor's Scope of Work, include condition of compliance to the *Federal Halocarbon Regulations* in addition to the ROEC-issued Halocarbon Management Procedure.

Ensure your contractor fully completes the all forms* found in the site's blue Service Log Book.

*Note that forms must be completed for all service events, including installations

Appendix L

Hydrocarbon Systems Work Flow

Fisheries and Oceans Canada | Pêches et Océans Canada

ROEC, 2019

Environmental Compliance

Regional Office of Environmental Coordination

Halocarbon Systems Work Flow

for Large and Small Installed Systems, as well as Fixed Fire Extinguishing Systems (halocarbon-containing)

According to the Federal Halocarbon Regulations (FHR), a only a 'certified person' may install, service, leak test or charge a refrigeration or air-conditioning system or do any other work on the system that may result in the release of a halocarbon.

Certification is obtained through the Heating, Refrigeration and Air-Conditioning Institute of Canada (HRAI)

Large Installed Halocarbon Systems (≥19 kW)

- Enlist the assistance of a Certified Technician. Ensure all large systems are leak tested once every 12 months.
- Document the technician's ozone-depleting substance (ODS) certification number. Photocopy of the technician's certification.
- Provide the technician with the FHR *Contractor Awareness Document*.
- Ensure **all documentation (service logs and records)** are **completely filled out.**
- Keep/file all documentation for no less than 5 years.

Small Installed Halocarbon Systems (<19 kW)

- Enlist the assistance of a Certified Technician.
- Document the technician's ozone-depleting substance (ODS) certification number.
- Provide the technician with the FHR *Contractor Awareness Document*.
- Ensure **all documentation (service logs and records)** are **completely filled out.**
- Keep/file all documentation for no less than 5 years.

Fixed Fire Extinguishing & Suppression Systems (Halon)

- Enlist the assistance of a Fire System Professional (technicians working on fire-extinguishing systems do not need to be certified like refrigeration systems)
- Fixed Fire Extinguishing and Suppression (FES) Systems must be leak tested once every 12 months.
- **Prior to servicing a fixed fire suppression system**, the owner must be notified and a notice must be affixed to the control panel indicating that it is out of operation during the period of service.
- Provide the technician with the FHR *Contractor Awareness Document*.
- Ensure **all documentation (service logs and records)** are **completely filled out.**
- Keep/file all documentation for no less than 5 years.

Technicians must have

- a valid Trade Qualification Certificate for Halocarbons;
- completed "Environmental Awareness in Ozone-Depleting Substance" training (*provided through their own company, not by DFO*);
- an understanding of of the Refrigeration Code of Practice or the Servicing of Halon Extinguishing Systems (ULC/ORD-C1058.18-1993);
- reviewed the FHR 'Contractor Awareness Document'

Need more information?

Contact

ROECpacific@dfo-mpo.gc.ca

Read

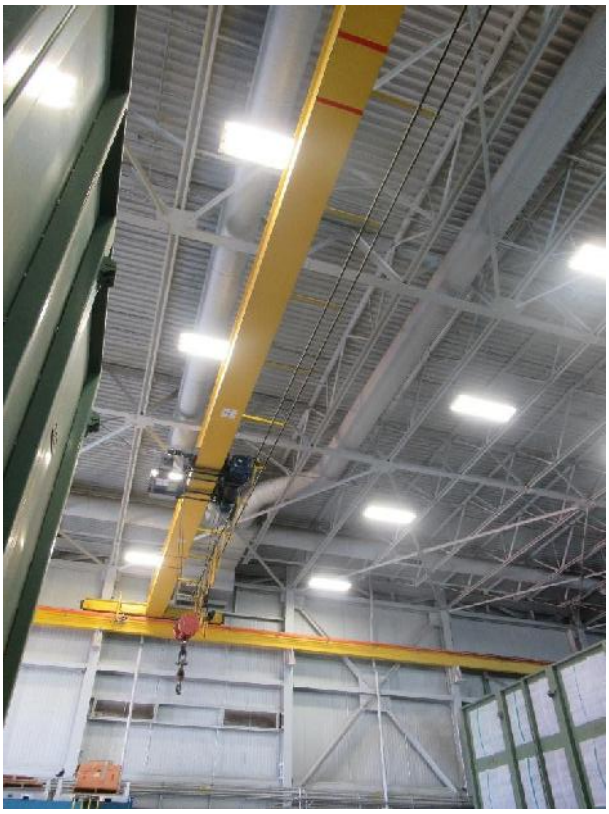
the Halocarbon Management Procedure

Canada

Appendix M

List of Photos

General



xEF-6

(Note: Tag on photo “EF-1”)

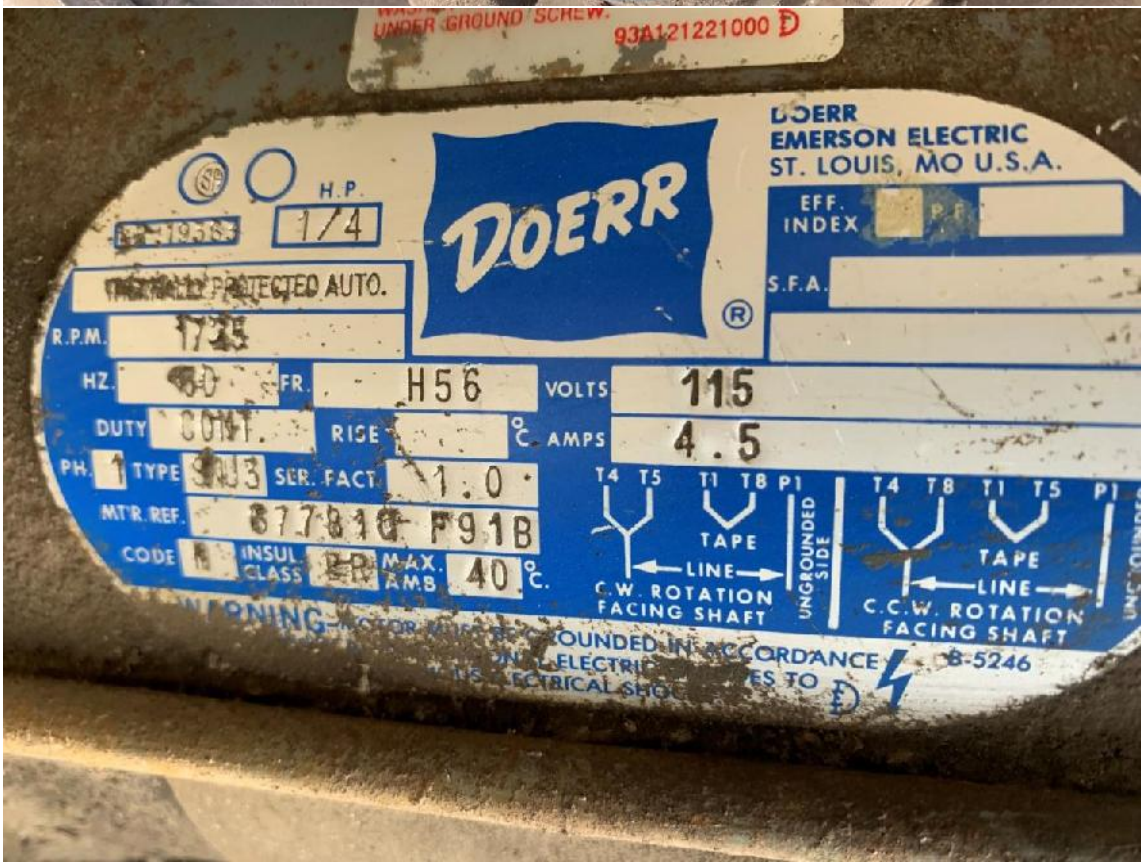

EF-1
PAINT KITCHEN
COOK
ALARM


SPRINKLER
IF BELL RINGS
CALL POLICE
OR
ALARM

xEF-7

(Note: Tag on photo “EF-2”)


EF-2
PAINT KITCHEN


UNDER GROUND SCREW.
93A121221000 D
DOERR
EMERSON ELECTRIC
ST. LOUIS, MO U.S.A.
H.P.
1/4
THERMALLY PROTECTED AUTO.
R.P.M. 1725
HZ. 60
FR. H56
VOLTS 115
DUTY CONT.
RISE °C
AMPS 4.5
PH. 1
TYPE
SER. FACT. 1.0
MT'R. REF. 617816 F91B
CODE
INSUL CLASS
MAX. AMB. 40 °C.
EFF.
INDEX
P.F.
S.F.A.
T4 T5 T1 T8 P1
TAPE
LINE
C.W. ROTATION FACING SHAFT
UNGROUNDED SIDE
T4 T8 T1 T5 P1
TAPE
LINE
C.C.W. ROTATION FACING SHAFT
ACCORDANCE
B-5246


DOERR
DOERR
EMERSON ELECTRIC
ST. LOUIS, MO U.S.A.
115
4.5
TAPE
LINE
UNGROUNDED
STOP


MANUEL MOTEUR
STARTER SWITCH
INTERRUPTEUR MANUEL
DE MOTEUR