
PROJECT MANUAL

Parks Canada Agency TERRA NOVA VISITOR CENTRE Rehabilitation Upgrades

Terra Nova National Park.
Glovertown, Newfoundland

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END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK

- .1 Site of Work is at: Terra Nova Visitor Centre located at Glovertown, Newfoundland.
- .2 General renovations and upgrades to architectural, structural, mechanical, electrical, and civil systems at the Terra Nova Visitor Centre, including new exhibit installations and associated systems.
- .3 The General Contractor will be responsible for coordinating the efforts and outputs between the Exhibit Contractor's Team and the Project Architect's Team.

1.2 FAMILIARIZATION WITH SITE

- .1 Before submitting a bid, it is recommended that bidders visit the site to review and verify the form, nature and extent of the work, materials needed, the means of access and the temporary facilities required to perform the Work.
- .2 Obtain prior permission from the Departmental Representative before carrying out such site inspection.

1.3 CODES AND STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada (NBCC) 2015 for Newfoundland and National Fire Code of Canada (NFC) 2015, and any other code of provincial or local application, including all amendments up to bid closing date, provided that in any case of conflict or discrepancy, the more stringent requirement shall apply.
- .2 Materials and workmanship must meet or exceed requirements of specified standards, codes and referenced documents.

1.4 INTERPRETATION OF DOCUMENTS

- .1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.5 TERM ENGINEER

- .1 Unless specifically stated otherwise, the term Engineer where used in the Specifications and on the Drawings shall mean the Departmental Representative as defined in the General Conditions of the Contract.

1.6 SETTING OUT WORK

- .1 Departmental Representative will set stakes to define location, alignment and elevations of work. Give Departmental Representative reasonable notice of construction layout requirements.

- .2 Departmental Representative will provide only those survey control points and set such stakes as necessary to define general location, alignment and elevations of work. Give Departmental Representative reasonable notice of requirements for such control points and stakes.
- .3 Set grades and lay out work in detail from control points and grades established by Departmental Representative.
- .4 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .5 Provide devices needed to lay out and construct work.
- .6 Supply such devices as straight edges and templates required to facilitate Departmental Representative's inspection of work.
- .7 Supply stakes and other survey markers required for laying out work.

1.7 COST BREAKDOWN

- .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by Departmental Representative and aggregating contract amount. Required forms will be provided for application of progress payment.
- .2 List items of work numerically following the same division/section number system of the specification manual and thereafter sub-divide into major work components and building systems as directed by Departmental Representative.
- .3 Upon approval, cost breakdown will be used as basis for progress payment.

1.8 MEASUREMENT PROCEDURES

- .1 Notify Departmental Representative sufficiently in advance of operations to permit required measurement procedures.

1.9 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each of the following:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda and amendments.
 - .4 Reviewed Shop Drawings.
 - .5 List of outstanding shop drawings.
 - .6 Change Orders.
 - .7 Other modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and other safety related documents.
 - .11 Other documents as stipulated elsewhere in the Contract Documents.

1.10 PERMITS

- .1 In accordance with the General Conditions, obtain and pay for building permit, certificates, licenses and other permits as required by municipal, provincial and federal authorities.
- .2 Provide appropriate notifications of project to municipal and provincial inspection authorities.
- .3 Obtain compliance certificates as prescribed by legislative and regulatory provisions of municipal, provincial and federal authorities as applicable to the performance of work.
- .4 Submit to Departmental Representative, copy of application forms and approval documents received from above referenced authorities.

1.11 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Where security has been reduced by work of Contract, provide temporary means to maintain security.
- .3 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas which will be operative during such work.

1.12 ROUGHING-IN

- .1 Be responsible for obtaining manufacturer's literature and for correct roughing-in and hook-up of equipment, fixtures and appliances.

1.13 CUTTING, FITTING AND PATCHING

- .1 Ensure that cutting and patching required by all trades is included in total bid amount submitted for the work.
- .2 Execute cutting, fitting and patching required to make work fit properly.
- .3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work. This includes patching of openings in existing work resulting from removal of existing services.
- .4 Do not cut, bore, or sleeve load-bearing members, except where specifically approved by Departmental Representative.
- .5 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .6 Fit work airtight to pipes, sleeves ducts and conduits.

1.14 CONCEALMENT

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

1.15 LOCATION OF FIXTURES

- .1 Location of equipment, fixtures and outlets, shown or specified shall be considered as approximate. Actual location shall be as required to suit conditions at time of installation and as is reasonable.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative when impending installation conflicts with other new or existing components. Follow directives for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.16 EXISTING SERVICES

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian, vehicular traffic and tenant operations.
- .2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.
- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. This includes disconnection of electrical power and communication services to tenant's operational areas. Adhere to approved schedule and provide notice to affected parties.
- .4 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .5 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services as required. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction over service. Record locations of maintained, re-routed and abandoned service lines.

1.17 BILINGUAL NOTATIONS

- .1 Any items supplied and installed under this contract which have operating instructions on them such as door hardware, washroom accessories, push button activation controls powered hand dryers, mechanical equipment such as water coolers, etc., and which can be expected to be used by the public, must have such operating instructions in bilingual format - English and French.
- .2 Factory embossed or recessed symbols illustrating equipment operation is an acceptable alternate to lettering.

- .3 Items supplied with factory - embossed or recessed lettering in one official language with an applied sticker or decal representing the second official language is not acceptable unless the Departmental Representative gives prior approval before any such items are ordered.
- .4 Internationally recognized colour coding such as red and blue center pieces for plumbing brass is acceptable.
- .5 No extra costs will be paid for re-stocking or re-ordering of materials and equipment due to Contractor's failure to fully meet bilingual signage requirements specified herein.
- .6 Ensure that all trades are made aware of above requirements.

1.18 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

1.19 ASBESTOS DISCOVERY

- .1 Demolition of spray or trowel-applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered in course of work, stop work and notify Departmental Representative immediately. Do not proceed with relevant work until written instructions have been received from Departmental Representative.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Upon acceptance of bid and prior to commencement of work, submit to Departmental Representative the following work management documents:
 - .1 Work Schedule as specified herein.
 - .2 Shop Drawing Submittal Schedule specified in section 01 33 00.
 - .3 Waste Management Plan specified in section 01 74 21.
 - .4 Environmental Plan specified in section 01 35 43.
 - .5 Health and Safety Plan specified in section 01 35 29.
 - .6 Dust Control Plan specified in section 01 50 00.
 - .7 List of workers requiring security clearance and those to be placed on Site Security Control list as specified in section 01 35 54.

1.2 WORK SCHEDULE

- .1 Upon acceptance of bid submit:
 - .1 Detailed work schedule within 21 calendar days of contract award.
- .2 Schedule to indicate all calendar dates from commencement to completion of all work within the time stated in the accepted bid.
- .3 Provide sufficient details in preliminary schedule to clearly illustrate entire implementation plan, depicting efficient coordination of tasks and resources, to achieve completion of work on time and permit effective monitoring of work progress in relation to established milestones.
- .4 Work schedule content to include as a minimum the following:
 - .1 Bar (GANTT) Charts, indicating all work activities, tasks and other project elements, their anticipated durations, planned dates for achieving key activities and major project milestones supported with;
 - .2 Written narrative on key elements of work illustrated in bar chart, providing sufficient details to demonstrate a reasonable implementation plan for completion of project within designated time.
 - .3 Generally, Bar Charts derived from commercially available computerized project management system are preferred but not mandatory.
- .5 Detailed Work Schedule:
 - .1 Prepare by use of Critical Path Method (CPM) indicating:
 - .1 Complete and detailed sequence of all construction activities. Show projected start and completion dates for each activity.
 - .2 Number of calendar days required to carryout each activity.
 - .3 Critical path items with resulting critical dates, non-critical activities and resulting float time.
 - .4 Actual workdays from non-working days such as weekend and statutory days etc.

- .5 Projected and actual percentage of work completed for each major work activity.
- .2 Prepare CPM schedule by use of well recognized and widely used electronic software. Submit copy of schedule in paper format and one electronic version on diskette for each submission.
- .3 Accompany CPM with written narrative as required and in sufficient detail to fully describe work and demonstrate a reasonable implementation plan for completion of project within designated time.
- .6 Work schedule must take into consideration and reflect the special conditions and operational restrictions as and indicated on drawings.
- .7 Schedule work in cooperation with the Departmental Representative. Incorporate within Detailed Work Schedule, items identified by Departmental Representative during review of preliminary schedule.
- .8 Completed schedule shall be approved by Departmental Representative. When approved, take necessary measures to complete work within scheduled time. Do not change schedule without Departmental Representative's approval.
- .9 Ensure that all subtrades and subcontractors are made aware of the work restraints and operational restrictions specified.
- .10 Schedule Updates:
 - .1 Submit on a monthly basis when requested by Departmental Representative.
 - .2 Provide information and pertinent details explaining reasons for necessary changes to implementation plan.
 - .3 Identify problem areas, anticipated delays, impact on schedule and proposed corrective measures to be taken.
- .11 Departmental Representative will make interim reviews and evaluate progress of work based on approved schedule. Frequency of such reviews will be as decided by Departmental Representative. Address and take corrective measures on items identified by reviews and as directed by Departmental Representative. Update schedule accordingly.
- .12 In every instance, change or deviation from the Work Schedule, no matter how minimal the risk or impact on safety or inconvenience to tenant or public might appear, will be subject to prior review and approval by the Departmental Representative.

1.3 PROJECT PHASING

- .1 Be aware that Facility and tenants must be kept operational for the full duration of work of this contract. Building services to areas under use by tenants must also be maintained at all times during the Facility's operational hours and as specifically defined in [operational restrictions] specified in this section.
- .2 Unless indicated or approved otherwise, complete all work of a particular phase prior to commencement of another phase. Obtain Departmental Representative's permission prior to moving between phases.

1.4 OPERATIONAL RESTRICTIONS

- .1 The Contractor must recognize that building occupants will be affected by implementation of this Contract. The Contractor must perform the work with utmost regard to the safety and convenience of building occupants and users. All work activities must be planned and scheduled with this in mind. The Contractor will not be permitted to disturb any portion of the building without providing temporary facilities as necessary to ensure safe and direct passage through disturbed or otherwise affected areas.
- .2 Contractor to meet with the Departmental Representative on a weekly basis to identify intended work areas, activities and scheduling for the coming week.
- .3 To assure that construction work may proceed productively without risk to safety of building occupants and the public, and due to the nature of the tenant's operation be aware that certain work of this contract must be carried out during "Off-Hours".
- .4 Off Hours: means a period of time which is outside the daily operational hours of the tenants of the Facility. For the purposes of this contract, Off-Hours are defined as follows:
 - .1 Weeknight Off-Hours: between the hours of 18:00 and 07:00 for each weekday Monday to Thursday inclusive.
 - .2 Weekend Off-Hours: between the hours of 18:00 Friday evening to 07:00 Monday morning.
 - .3 Dependent on the nature and location of the construction activity and due to an unanticipated operational requirement of the Tenant, certain off-hour periods may be redefined by adjusting the start and end time periods or cancellation of a specific off-hour work shift during the course of the Work.
- .5 The following work shall be performed during Off-Hours:
 - .1 Erection and dismantling of dust barriers, hoarding or other protective devices to separate areas of Facility occupied and under use by public and tenants from work areas;
 - .2 Erection of site enclosure fencing and temporary hoarding at building entrances and fire exits to keep them operational during work;
 - .3 Asbestos abatement;
 - .4 Demolition of any masonry or concrete inside building;
 - .5 All work involving saw cutting or boring of openings through masonry and concrete walls, floors, ceilings or roof;
 - .6 Work which requires the use of products controlled by WHMIS and for which MSDS sheets indicate toxic or hazardous materials requiring special handling and application procedures;
 - .7 Use of materials having high solvent content or other content emitting strong noxious fumes or odours;
 - .8 Painting or repainting;
 - .9 Removal of demolition debris from the building including cleaning of premises;
 - .10 Cleaning and preparing of occupied areas for daytime use by tenants immediately following an off-hour work shift;
 - .11 Work within a tenant occupied area including corridors, stairwells and other circulation routes under use;

- .12 Work which requires the temporary disconnection of power and communication services to occupied areas;
- .13 Testing of fire alarms and other emergency annunciating system;
- .14 Delivery of materials and equipment from exterior to the interior of building when access routes are located in tenant occupied spaces.
- .15 Work which creates excessive noise or vibration creating interference with tenant operations.
- .6 Departmental Representative reserves the right to stop certain daytime work activities, if the nature of that activity generates excessive noise or dust and have Contractor re-schedule that particular work to be performed during the Off-Hour period.
- .7 Ensure that all trades are aware of the "Off-Hour" requirements of this Contract and ensure that any extra costs incurred as a result is included in the Contractor's bid amount for the work. No extra cost will be paid due to failure by General Contractor or his sub-contractors to recognize the off-hour requirements and other restrictions specified herein and to include all necessary allowances within their bids.
- .8 See section 01 35 54 in regard to:
 - .1 Special security requirements which must be observed in the course of work.
 - .2 Provision of security personnel by Contractor as part of the Work.
- .9 Limited Manoeuvring Space on Site
- .10 Facility circulation maintained:
 - .1 Ensure that entrances, corridors, stairwells, fire exits, and other circulation routes are maintained free and clear providing safe and uninterrupted passage for Facility users and public at all times during the entire work.
 - .2 Maintain those areas clean and free of construction materials and equipment. Provide temporary dust barriers and other suitable enclosures to ensure users are not exposed to construction activities and are protected from exposure to dust, noise and hazardous conditions.
 - .3 Provide temporary corridors, walkways, passageways, access to offices, etc. when required due to nature of work. Such circulation routes must be constructed to barrier free requirements unless approved otherwise by Departmental Representative.
 - .4 Maintain fire escape routes accessible and fire fighting access open all times for the duration of the project.
 - .5 Do not under any circumstances block fire exit doors. Do not leave construction materials or debris in corridors, stairwells building entrances and exits.
- .11 Safety Signage:
 - .1 Provide on site, and erect as required during progress of work, proper bilingual signage, mounted on self-supporting stands, warning the public and building occupants of construction activities in progress and alerting need to exercise caution in proceeding through disturbed areas of the facility, and directing building occupants through any detours which may be required.
 - .2 Signage to be professionally printed and mounted on wooden backing, coloured and to express messages as directed by the Departmental Representative.

- .3 Generally maximum size of sign should be in the order of 1.0 square meters. Number of signs required will be dependent on number of areas in facility under renovation at any one time.
- .4 Include costs for the supply and installation of these signs in the bid amount.
- .12 Dust and Dirt Control:
 - .1 See section [01 50 00] and 01 74 11 for dust control and cleaning requirements.
 - .2 Effectively plan and implement dust control measures and cleaning activities as an integral part of all construction activities. Review all measures with the Departmental Representative before undertaking work, especially for major dust generating activities.
 - .3 Do not allow demolition debris and construction waste to accumulate on site and contribute to the propagation of dust.
 - .4 As work progresses, maintain construction areas in a tidy condition at all times. Remove gross dust accumulations by cleaning and vacuuming immediately following the completion of any major dust generating activity.
 - .5 Immediately remove all debris and dust from within occupied areas as generated by work therein during a given work shift.
 - .6 Disconnect and seal-off ductwork of HVAC servicing the construction area to stop spread of dust into other areas of Facility.
 - .7 Avoid situations and practises which results in dust and dirt being brought from the construction areas or from the exterior and tracked inside the building into occupied areas used by tenants and the public.
 - .8 Stop workers with soiled footwear from entering building. This includes roofing mechanics and heavy civil workers.
 - .9 Inform workers and make them sensitive to the need for dust and dirt control. Stringently enforce rules and regulations, immediately address non-compliance.
 - .10 Keep access doors to work areas closed at all times. Use only designated doors for entry or egress.
- .13 Work in Occupied Areas:
 - .1 Where work must be carried out in an occupied area beyond the boundaries of the enclosed construction site, perform such work during the non-operational off-hour periods of the Facility.
 - .2 Ensure that all dust, dirt, debris, construction waste, materials, tools and equipment are completely removed at the end of each ["off-hour"] work shift. Clean and reinstate area ready for daytime use by tenant.
 - .3 Provide temporary dust barriers around immediate work areas and place fabric drop sheets over workstations, equipment and other furnishings located immediately adjacent to such work.
 - .4 Conduct work in such a way as to minimize the creation of dust and to avoid contaminating areas beyond the immediate location.
 - .5 Discuss and obtain Departmental Representative's approval beforehand on the type and extent of dust barriers, protective devices and measures needed.
 - .6 Be responsible for temporarily moving office furnishings, workstations, computer equipment and other objects as needed to gain access and conduct work. Reinstall all dislocated items at end of each work shift making the area operational again.

- .7 Disconnect and reconnect any power and communications systems feeding workstations as required.
- .8 Clean such areas as well as those corridors and routes used to gain entry and access.
- .14 Cleaning of tenant occupied areas used by Contractor:
 - .1 Clean lobbies, corridors, stairs and other circulation routes used by workers to gain access to work by conducting cleaning, vacuuming and washing of floors, walls and other soiled surfaces.
 - .2 Obtain and pay for the services of a professional cleaning company to perform this cleaning. Cleaning staff shall remain on site one hour beyond the end of each off-hour work shifts to address any Tenant complaints or concerns and carryout additional cleaning functions as directed by Departmental Representative or by a pre-designated person(s) representing the tenant(s).
 - .3 Meager attempts at controlling dust and ineffective unprofessional cleaning procedures will not be tolerated.
 - .4 Failure to provide effective dust control, allowing construction dust and dirt to escape beyond construction areas and contaminate occupied areas and building circulation areas will result in Contractor being ordered to immediately provide professional cleaning services without delay to remedy the situation and conduct all cleaning to the extent as determined by Departmental Representative. Alternatively, Departmental Representative may, at certain times and at own discretion, obtain the services of an independent building cleaning agency when cleaning being provided by Contractor is ineffective or tardy in response.
- .15 Ensure that all sub-trades are made aware of and abide by the contents of this section and in particularly the work restrictions specified herein due to tenant operational requirements.

1.5 PROJECT MEETINGS

- .1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording minutes.

1.6 WORK COORDINATION

- .1 General Contractor is responsible for coordinating the work of the various trades and predetermining where the work of such trades interfaces with each other.
 - .1 Designate one person from own employ having overall responsibility to review contract documents and shop drawings, plan and manage such coordination.
- .2 General Contractor shall convene meetings between trades whose work interfaces and ensure that they are fully aware of the areas and the extent of where interfacing is required.
 - .1 Provide each trade with the plans and specs of the interfacing trade, as required, to assist them in planning and carrying out their respective work.
 - .2 Develop coordination drawings when deemed required illustrating potential interference between work of various trades and distribute to all affected parties including structural trade.
 - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.

- .2 Coordination drawings to identify all building elements, services lines, rough-in points and indicate from where various services are coming.
 - .3 Review coordination drawings at purposely called meetings. Have subcontractors sign-off on drawings and publish minutes of each meeting.
 - .4 Plan and coordinate work in such a way to minimize quantity of service line offsets.
 - .5 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.
- .3 Submission of shop drawings and ordering of prefabricated equipment or prebuilt components shall only occur once coordination meeting for such items has taken place between trades and all conditions affecting the work of the interfacing trades has been made known and accounted for.
- .4 Work Cooperation:
 - .1 Ensure cooperation between trades in order to facilitate the general progress of the work and avoid situations of spatial interference.
 - .2 Ensure that each trade provides all other trades reasonable opportunity for the completion of the work and in such a way as to prevent unnecessary delays, cutting, patching and the need to remove and replace completed work.
- .5 No extra costs to the Contract will be considered by the Departmental Representative as a result of Contractor's failure to effectively coordinate all portions of the Work. Disputes between the various trades as a result of their not being informed of the areas and extent of interface work shall be the sole responsibility of the General Contractor to be resolved at own cost.

END OF SECTION

Part 1 General**1.1 GENERAL**

- .1 The Departmental Representative will supply certain material and equipment in the Contract for installation and incorporation into the Work by the Contractor.

1.2 DELIVERY REQUIREMENTS

- .1 Materials supplied by the Departmental Representative will be turned over to the Contractor immediately upon receipt.
- .2 Within three 3 calendar days of receipt of material supplied by Departmental Representative, the Contractor must:
 - .1 Conduct a complete audit to verify that all materials have been received, including loose parts and accessories associated with a particular item;
 - .2 Acknowledge receipt, identify any missing or damaged items, in writing;
 - .3 Provide copy of delivery slips submitted by manufacturer and shipping company.
- .3 Unless shortages of material or damaged items are identified in writing to the Departmental Representative within the above specified period, the Contractor will become responsible to supply all missing materials and repair or replace damaged items and missing parts discovered thereafter at own expense.
- .4 Failure to make a complete check of supplied materials or to acknowledge receipt of same shall not relieve Contractor's responsibility to replace or repair any item subsequently found to be missing or damaged.
- .5 Departmental Representative will make final determination as to whether an item can be repaired or must be replaced.
- .6 In the event of failure on the part of the Contractor to submit written proof within the specified verification period, Departmental Representative reserves the right to:
 - .1 Proceed with the supply or repair of missing items through independent sources and;
 - .2 Charge costs of such items, including related shipping charges, to the General Contractor through assessments against the Contract.

1.3 CONTRACTOR'S DUTIES

- .1 Take possession of the supplied material immediately upon delivery to the site by shipping company.
- .2 Promptly inspect delivered material. Report missing, damaged or defective items in writing to Departmental Representative in accordance with delivery requirements specified above.
- .3 Obtain and pay costs to load and transport to work area.

- .4 Unload and handle at site, including lifting, uncrating etc.
- .5 Store material on site at a location designated by Departmental Representative. Protect against inclement weather and site damage by use of appropriate covers.
- .6 Make all arrangements and pay associated costs to provide temporary storage from date of receipt and until ready for incorporation into the work.
 - .1 Type and location of storage to meet with Departmental Representative's approval.
- .7 Be responsible for the protection of such material against damage, loss, theft and fire from date of receipt, during [transportation], loading, unloading, temporary storage and until final installation of work is accepted by the Departmental Representative.
- .8 Any damage or loss of such material shall result in the Contractor being responsible for replacement or repair of equipment at no additional cost to the Contract.
- .9 The decision as to whether damaged items may be repaired or must be replaced with new equipment shall be the Departmental Representative's decision.
- .10 Install such material and equipment and incorporate into the work. Perform assembly and make all connections as required to make item functional.
- .11 Dispose of containers, crating and protective covering off site as directed by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00: Closeout Submittals.

1.2 SUBMITTAL GENERAL REQUIREMENTS

- .1 Submit to Departmental Representative for review requested submittals specified in various sections of the specifications including shop drawings, samples, permits, compliance certificates, test reports, work management plans and other data required as part of the work.
- .2 Submit with reasonable promptness and in orderly sequence so as to allow for Departmental Representative's review and not cause delay in Work. Failure to submit in ample time will not be considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed.
- .3 Do not proceed with work until relevant submissions have been reviewed.
- .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units, provide soft converted values.
- .6 Review submittals prior to submission. Ensure that necessary requirements have been determined and verified and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
 - .1 Submittals not stamped, signed, dated and identified as to specific project will be returned unexamined by Departmental Representative and considered rejected.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .9 Contractor's responsibility for errors, omissions or deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review.
- .10 Submittal format:
 - .1 Submit paper originals, or alternatively clear and fully legible photocopies of originals. Facsimiles are not acceptable, except in special circumstances pre-approved by Departmental Representative. Poorly printed non-legible photocopies or facsimiles will not be accepted and be returned for resubmission.
 - .2 Submit in electronic format as pdf files. Forward pdf and in the native program format, through email or alternate PCA electronic file sharing service such as ftp, as directed by Departmental Representative.
- .11 Make changes or revision to submissions which Departmental Representative may require, consistent with Contract Documents and resubmit as directed by Departmental Representative. When resubmitting, identify in writing of any revisions other than those requested.

- .12 Keep one reviewed copy of each submittal document on site for duration of Work.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means fabrication drawings, erection drawings, diagrams, illustrations, schedules, performance charts, technical product data, brochures, specifications, test reports installation instructions and other data which are to be provided by Contractor to illustrate compliance with specified materials and details of a portion of work.
- .2 Shop Drawing Submittal Schedule:
 - .1 Submit within 15 working days of acceptance of bid a schedule listing all shop drawings to be submitted for project.
 - .2 Schedule shall be in format acceptable to Departmental Representative and indicate proposed submission date for each item, status of review and anticipated product delivery date to site. Track all submissions for entire project.
 - .3 Revise schedule as work progresses. Identify items which have been reviewed and finalized and indicating those outstanding.
 - .4 Update schedule at stipulated dates or project time intervals predetermined and agreed upon with Departmental Representative at commencement of Work.
- .3 Shop Drawing Quantities: submit sufficient copies required by the General Contractor and sub-contractors plus 3 copies which will be retained by Departmental Representative.
 - .1 Ensure sufficient copies are submitted to enable one complete set to be included in each of the maintenance manuals specified in 01 78 00.
- .4 Shop Drawings Format:
 - .1 Opaque white prints or photocopies of original drawings or standard drawings modified to clearly illustrate work specific to project requirements. Maximum sheet size to be 1000 x 707 mm.
 - .2 Product Data from manufacturer's standard catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products, to be original full colour brochures, clearly marked indicating applicable data and deleting information not applicable to project.
 - .3 Non or poorly legible drawings, photocopies or facsimiles will not be accepted and returned not reviewed.
- .5 Shop Drawings Content:
 - .1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where items or equipment attach or connect to other items or equipment, confirm that all interrelated work has been coordinated, regardless of section or trade from which the adjacent work is being supplied and installed.
 - .2 Supplement manufacturer's standard drawings and literature with additional information to provide details applicable to project.
 - .3 Delete information not applicable to project on all submittals.

- .4 Equipment installation/start-up data: include manufacturer's recommended installation instructions, pre-start and start-up checklists for those pieces of equipment and systems designated to be commissioned.
- .6 Allow 14 calendar days for Departmental Representative's review of each submission.
- .7 Adjustments or corrections made on shop drawings by Departmental Representative are not intended to change Contract Amount. If adjustments affect value of Work, advise Departmental Representative in writing prior to proceeding with Work.
- .8 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections and comments are made, fabrication and installation may proceed upon receipt of shop drawings. If shop drawings are rejected and noted to be Resubmitted, do not proceed with that portion of work until resubmission and review of corrected shop drawings, through same submission procedures indicated above.
- .9 Be advised that costs and expenses incurred by Departmental Representative to conduct more than one review of incorrectly prepared shop drawing submittal for a particular material, equipment or component of work may be assessed against the Contractor.
- .10 Accompany each submission with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and project number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .11 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and project 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 Cross references to particular details of contract drawings and specifications section number for which shop drawing submission addresses.
 - .6 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.
- .12 After Departmental Representative's review, distribute copies.
- .13 The review of shop drawings by the Departmental Representative or by an authorized Consultant or designate is for sole purpose of ascertaining conformance with general concept. This review shall not mean that Canada approves the detail design inherent in the 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 all requirements of the construction and Contract Documents. 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 all sub-trades.

1.4 SAMPLES

- .1 Submit for review samples as specified in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples to Departmental Representative's office or to other address as directed. Do not drop off samples at construction site except for pre-approved circumstances previously approved by Departmental Representative.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Amount. If adjustments will result in a cost increase to the Contract notify Departmental Representative in writing prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fire Safety Requirements.
- .2 Hot Work Permit.
- .3 Existing Fire Protection and Alarm Systems.

1.2 RELATED SECTIONS

- .1 Section 01 35 29: Health and Safety Requirements.

1.3 REFERENCES

- .1 National Fire Code 2015
- .2 National Building Code 2015

1.4 DEFINITIONS

- .1 Hot Work defined as:
 - .1 Welding work.
 - .2 Cutting of materials by use of torch or other open flame devices.
 - .3 Grinding with equipment which produces sparks.
 - .4 Use of open flame torches such as for roofing work.

1.5 SUBMITTALS

- .1 Submit copy of Hot Work Procedures and sample of Hot Work permit to Departmental Representative for review, within 14 calendar days of acceptance of bid.
- .2 Submit in accordance with section 01 33 00.

1.6 FIRE SAFETY REQUIREMENTS

- .1 Implement and follow fire safety measures during Work. Comply with following:
National Fire Code 2010.
National Building Code 2015.
Federal and Provincial Occupational Health and Safety Acts and Regulations.
- .2 In event of conflict between any provisions of above authorities the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, Departmental Representative will advise on the course of action to be followed.

1.7 HOT WORK AUTHORIZATION

- .1 Obtain Departmental Representative's written "Authorization to Proceed" before conducting any form of Hot Work on site.
- .2 To obtain authorization submit to Departmental Representative:
Contractor's typewritten Hot Work Procedures to be followed on site as specified below.
Description of the type and frequency of Hot Work required.
Sample Hot Work Permit to be used.
- .3 Upon review and confirmation that effective fire safety measures will be implemented and followed during performance of hot work, Departmental Representative will give authorization to proceed as follows:
 - .1 Issue one written "Authorization to Proceed" covering the entire project for duration of work or;
 - .2 Subdivide the work into pre-determined, individual activities, each activity requiring a separately written authorization to proceed.
- .4 Requirement for individual authorization will be based on:
Nature or phasing of work;
Risk to Facility operations;
Quantity of various trades needing to perform hot work on project or;
 - .1 Other situation deemed necessary by Departmental Representative to ensure fire safety on premises.
- .5 Do not perform any Hot Work until receipt of Departmental Representative's written "Authorization to Proceed" for that portion of work.
- .6 In tenant occupied Facility, coordinate performance of Hot Work with Facility Manager through the Departmental Representative. When directed, perform Hot Work only during non-operative hours of the Facility. Follow Departmental Representative's directives in this regard.

1.8 HOT WORK PROCEDURES

- .1 Develop and implement safety procedures and work practices to be followed during the performance of Hot Work.
- .2 Hot Work Procedures to include:
 - .1 Requirement to perform hazard assessment of site and immediate work area beforehand for each hot work event in accordance with Safety Plan specified in section 01 35 29.
 - .2 Use of a Hot Work Permit system with individually issued permit by Contractor's Superintendent to worker or subcontractor granting permission to proceed with Hot Work.
 - .3 Permit required for each Hot Work event.
 - .4 Designation of a person on site as a Fire Safety Watcher responsible to conduct a fire safety watch for a minimum duration of 30-60 minutes immediately following the completion of the Hot Work.
 - .5 Compliance with fire safety codes, standards and occupational health and safety regulations specified.
 - .6 Site specific rules and procedures in force at the site as provided by the Facility Manager.

- .3 Generic procedures, if used, must be edited and supplemented with pertinent information tailored to reflect specific project conditions. Label document as being the Hot Work Procedures for this contract.
- .4 Procedures shall clearly establish responsibilities of:
 - .1 Worker performing hot work,
 - .2 Person issuing the Hot Work Permit,
 - .3 Fire Safety Watcher,
 - .4 Subcontractor(s) and Contractor.
- .5 Brief all workers and subcontractors on Hot Work Procedures and of Permit system. Stringently enforce compliance.

1.9 HOT WORK PERMIT

- .1 Hot Work Permit to include the following:
 - .1 Project name and project number;
 - .2 Building name and specific room or area where hot work will be performed;
 - .3 Date of issue;
 - .4 Description of hot work type needed;
 - .5 Special precautions to be followed, including type of fire extinguisher needed;
 - .6 Name and signature of permit issuer.
 - .7 Name of worker to which the permit is issued.
 - .8 Permit validity period not to exceed 8 hours. Indicate start time/date and termination time/date.
 - .9 Worker's signature with time/date of hot work completion.
 - .10 Stipulated time period of safety watch.
 - .11 Fire Safety Watcher's signature with time/date.
- .2 Permit to be typewritten form. Industry Standard forms shall only be used if all data specified above is included on form.
- .3 Each Hot Work Permit to be completed in full, signed and returned to Contractor's Superintendent for safe keeping on site.

1.10 FIRE PROTECTION AND ALARM SYSTEMS

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed.
 - .2 Shut-off, unless approved by Departmental Representative.
 - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Costs incurred, from the fire department, Facility owner [and tenants], resulting from negligently setting off false alarms will be charged to the Contractor.

1.11 DOCUMENTS ON SITE

- .1 Keep Hot Work Permits and Hazard assessment documentation on site for duration of Work.
- .2 Upon request, make available to Departmental Representative or to authorized safety Representative for inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Procedures to isolate and lockout electrical facility and other equipment from energy sources.

1.2 RELATED SECTIONS

- .1 Section 01 35 29 - Health and Safety Requirements

1.3 REFERENCES

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- .2 CAN/CSA-C22.3 No.1-06, Overhead Systems.
- .3 CSA C22.3 No.7-06, Underground Systems.
- .4 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.

1.4 DEFINITIONS

- .1 Electrical Facility: means any system, equipment, device, apparatus, wiring, conductor, assembly or part thereof that is used for the generation, transformation, transmission, distribution, storage, control, measurement or utilization of electrical energy, and that has an amperage and voltage that is dangerous to persons.
- .2 Guarantee of Isolation: means a guarantee by a competent person in control or in charge that a particular facility or equipment has been isolated.
- .3 De-energize: in the electrical sense, that a piece of equipment is isolated and grounded, e.g. if the equipment is not grounded, it cannot be considered de-energized (DEAD).
- .4 Guarded: means that an equipment or facility is covered, shielded, fenced, enclosed, inaccessible by location, or otherwise protected in a manner that, to the extent that is reasonably practicable, will prevent or reduce danger to any person who might touch or go near such item.
- .5 Isolate: means that an electrical facility, mechanical equipment or machinery is separated or disconnected from every source of electrical, mechanical, hydraulic, pneumatic or other kind of energy that is capable of making it dangerous.
- .6 Live/alive: means that an electrical facility produces, contains, stores or is electrically connected to a source of alternating or direct current of an amperage and voltage that is dangerous or contains any hydraulic, pneumatic or other kind of energy that is capable of making the facility dangerous to persons.

1.5 COMPLIANCE REQUIREMENTS

- .1 Comply with the following in regards to isolation and lockout of electrical facilities and equipment:

- .1 Canadian Electrical Code.
- .2 Federal and Provincial Occupational Health and Safety Acts and Regulations.
- .3 Regulations and code of practice as applicable to mechanical equipment or other machinery being de-energized.
- .4 Procedures specified herein.
- .2 In event of conflict between any provisions of above authorities the most stringent provision will apply.

1.6 SUBMITTALS

- .1 Submit copy of lockout procedures, sample of lockout permit and lockout tags proposed for use in accordance with Section 01 33 00 – Submittal Procedures. Submit within 14 calendar days of acceptance of bid.

1.7 ISOLATION OF EXISTING SERVICES

- .1 Obtain Departmental Representative's written authorization prior to working on existing live or active electrical facilities and equipment and before proceeding with isolation of such item.
- .2 To obtain authorization, submit to Departmental Representative the following documentation:
 - .1 Written request to isolate the particular service or facility and;
 - .2 Copy of Contractor's Lockout Procedures.
- .3 Make a Request for Isolation for each event, unless directed otherwise by Departmental Representative, as follows:
 - .1 Fill-out standard form in current use at the Facility as provided by Departmental Representative or;
 - .2 Where no form exists, make written request indicating:
 - .1 The equipment, system or service to be isolated and it's location;
 - .2 Duration of isolation period (ie: start time & date and completion time & date).
 - .3 Voltage of service feed to system or equipment being isolated.
 - .4 Name of person making the request.
- .4 Do not proceed with isolation until receipt of written notification from Departmental Representative granting the Isolation Request and authorizing to proceed with the work.
 - .1 Note that Departmental Representative may designate another person at the Facility being authorized to grant the Isolation Request.
- .5 Conduct safe, orderly shut down of equipment or facility. De-energize, isolate and lockout power and other sources of energy feeding the equipment or facility.
- .6 Determine in advance, as much as possible, in cooperation with the Departmental Representative, the type and frequency of situations which will require isolation of existing services.
- .7 Plan and schedule shut down of existing services in consultation with the Departmental Representative and the Facility Manager. Minimize impact and downtime of Facility operations. Follow Departmental Representative's directives in this regard.

- .8 Conduct hazard assessment as part of the process in accordance with health and safety requirements specified Section 01 35 29.

1.8 LOCKOUTS

- .1 De-energize, isolate and lockout electrical facility, mechanical equipment and machinery from all potential sources of energy prior to working on such items.
- .2 Develop and implement clear and specific lockout procedures to be followed as part of the Work.
- .3 Prepare typed written Lockout Procedures describing safe work practices, procedures, worker responsibilities and sequence of activities to be followed on site by workforce to safely isolate an active piece of equipment or electrical facility and effectively lockout and tagout it's sources of energy.
- .4 Include as part of the Lockout Procedures a system of lockout permits managed by Contractor's Superintendent or other qualified person designated by him/her as being "in-charge" at the site.
 - .1 A lockout permit shall be issued to specific worker providing a Guarantee of Isolation before each event when work must be performed on a live equipment or electrical facility.
 - .2 Duties of person managing the permit system to include:
 - .1 Issuance of permits and lockout tags to workers.
 - .2 Determining permit duration.
 - .3 Maintaining record of permits and tags issued.
 - .4 Making a Request for Isolation to Departmental Representative when required as specified above.
 - .5 Designating a Safety Watcher, when one is required based on type of work.
 - .6 Ensuring equipment or facility has been properly isolated.
 - .7 Collecting and safekeeping lockout tags returned by workers as a record of the event.
 - .5 Clearly establish, describe and allocate responsibilities of:
 - .1 Workers.
 - .2 Person managing the lockout permit system.
 - .3 Safety Watcher.
 - .4 Subcontractor(s) and General Contractor.
 - .6 Generic procedures, if used, must be edited and supplemented with pertinent information to reflect specific project requirements.
 - .1 Incorporate site specific rules and procedures in force at site as provided by Facility Manager through the Departmental Representative.
 - .2 Clearly label the document as being the Lockout procedures applicable to work of this contract.
 - .7 Use energy isolation lockout devices specifically designed and appropriate for type of facility or equipment being locked out.
 - .8 Use industry standard lockout tags.

- .9 Provide appropriate safety grounding and guards as required.

1.9 CONFORMANCE

- .1 Brief all workers and subcontractors on requirements of this section. Stringently enforce use and compliance.

1.10 DOCUMENTS ON SITE

- .1 Post Lockout Procedures on site in common location for viewing by workers.
- .2 Keep copies of Request for Isolation forms and lockout permits and tags issued to workers on site for full duration of Work.
- .3 Upon request, make available to Departmental Representative or to authorized safety representative for inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 35 24: Special Procedures on Fire Safety Requirements.

1.2 DEFINITIONS

- .1 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.
- .2 Competent Person: means a person who is:
 - .1 Qualified by virtue of personal knowledge, training and experience to perform assigned work in a manner that will ensure the health and safety of persons in the workplace, and;
 - .2 Knowledgeable about the provisions of occupational health and safety statutes and regulations that apply to the Work and;
 - .3 Knowledgeable about potential or actual danger to health or safety associated with the Work.
- .3 Medical Aid Injury: any minor injury for which medical treatment was provided and the cost of which is covered by Workers' Compensation Board of the province in which the injury was incurred.
- .4 PPE: personal protective equipment.
- .5 Work Site: where used in this section shall mean areas, located at the premises where Work is undertaken, used by Contractor to perform all of the activities associated with the performance of the Work.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan prior to commencement of Work.
 - .1 Submit within 5 work days of notification of Bid Acceptance. Allow for 5-10 days for Department review and recommendations prior to the commencement of work. Provide 3 copies.
 - .1 Departmental Representative will review Health and Safety Plan and provide comments.
 - .3 Revise the Plan as appropriate and resubmit within 10 work days after receipt of comments.
 - .2 Departmental Representative's review and comments made of the Plan shall not be construed as an endorsement, approval or implied warranty of any kind by Canada and does not reduce Contractor's overall responsibility for Occupational Health and Safety of the Work.
 - .3 Submit revisions and updates made to the Plan during the course of Work.
- .3 Submit name of designated Health and Safety Site Representative and support documentation specified in the Safety Plan.

- .4 Submit building permit, compliance certificates and other permits obtained.
- .5 Submit copy of Letter in Good Standing from Provincial Workers Compensation or other Department of Labour organization.
 - .1 Submit update of Letter of Good Standing whenever expiration date occurs during the period of Work.
- .6 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .7 Submit copies of incident reports.
- .8 Submit WHMIS MSDS - Material Safety Data Sheets.

1.4 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act for Province of Nova Scotia, and Regulations made pursuant to the Act.
- .2 Comply with Occupational Health and Safety Act for Province of New Brunswick, and General Regulations made pursuant to the Act.
- .3 Comply with Occupational Health and Safety Act for Province of Prince Edward Island, and Occupational Health and Safety Regulations made pursuant to the Act.
- .4 Comply with Occupational Health and Safety Act for Province of Newfoundland and Labrador, and Occupational Health & Safety Regulations made pursuant to the Act.
- .5 Comply with Canada Labour Code - Part II (entitled Occupational Health and Safety) and the Canada Occupational Health and Safety Regulations as well as any other regulations made pursuant to the Act.
 - .1 The Canada Labour Code can be viewed at: [www.http://laws-lois.justice.gc.ca/eng/acts/L-2/fulltext.html](http://laws-lois.justice.gc.ca/eng/acts/L-2/fulltext.html).
 - .2 Canadian Occupational Health and Safety Regulations can be viewed at: <http://laws-lois.justice.gc.ca/eng/regulations/SOR-86-304/index.html>.
 - .3 A copy may be obtained at: Canadian Government Publishing Public Works & Government Services Canada Ottawa, Ontario, K1A 0S9 Tel: 819-956-4800 or 1-800-635-7943 Publication No. L31-85/2000 (E or F).
- .6 Treasury Board of Canada Secretariat (TBS):
 - .1 Treasury Board, Fire Protection Standard April 1, 2010
www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316§ion=text.
- .7 Canadian Standards Association (CSA):
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .8 Observe construction safety measures of:
 - .1 NBC 2015, Division B, Part 8.

- .2 Municipal by-laws and ordinances.
- .9 In case of conflict or discrepancy between above specified requirements, the more stringent shall apply.
- .10 Maintain Workers Compensation Coverage in good standing for duration of Contract. Provide proof of clearance through submission of Letter in Good Standing.
- .11 Medical Surveillance: Where prescribed by legislation or regulation, obtain and maintain worker medical surveillance documentation.

1.5 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons and environment adjacent to the site to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by all workers, sub-contractors and other persons granted access to Work Site with safety requirements of Contract Documents, applicable federal, provincial, and local by-laws, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.6 SITE CONTROL AND ACCESS

- .1 Control the Work and entry points to Work Site. Approve and grant access only to workers and authorized persons. Immediately stop and remove non-authorized persons.
 - .1 Departmental Representative will provide names of those persons authorized by Departmental Representative to enter onto Work Site and will ensure that such authorized persons have the required knowledge and training on Health and Safety pertinent to their reason for being at the site, however, Contractor remains responsible for the health and safety of authorized persons while at the Work Site.
- .2 Isolate Work Site from other areas of the premises by use of appropriate means.
 - .1 Erect fences, hoarding, barricades and temporary lighting as required to effectively delineate the Work Site, stop non-authorized entry, and to protect pedestrians and vehicular traffic around and adjacent to the Work and create a safe environment. See Section 01 50 00 for minimum acceptable requirement.
 - .2 Post signage at entry points and other strategic locations indicating restricted access and conditions for access.
 - .3 Use professionally made signs with bilingual message in the 2 official languages or international known graphic symbols.
- .3 Provide safety orientation session to persons granted access to Work Site. Advise of hazards and safety rules to be observed while on site.
- .4 Ensure persons granted site access wear appropriate PPE. Supply PPE to inspection authorities who require access to conduct tests or perform inspections.
- .5 Secure Work Site against entry when inactive or unoccupied and to protect persons against harm. Provide security guard where adequate protection cannot be achieved by other means.

1.7 PROTECTION

- .1 Give precedence to safety and health of persons and protection of environment over cost and schedule considerations for Work.
- .2 Should unforeseen or peculiar safety related hazard or condition become evident during performance of Work, immediately take measures to rectify situation and prevent damage or harm. Advise Departmental Representative verbally and in writing.

1.8 FILING OF NOTICE

- .1 File Notice of Project with pertinent provincial health and safety authorities prior to beginning of Work.
 - .1 Departmental Representative will assist in locating address if needed.

1.9 PERMITS

- .1 Post permits, licenses and compliance certificates, specified in section 01 10 10, at Work Site.
- .2 Where a particular permit or compliance certificate cannot be obtained, notify Departmental Representative in writing and obtain approval to proceed before carrying out applicable portion of work.

PROJECT/SITE CONDITIONS

- .3

1.10 MEETINGS

- .1 Attend pre-construction health and safety meeting, convened and chaired by Departmental Representative, prior to commencement of Work, at time, date and location determined by Departmental Representative. Ensure attendance of:
 - .1 Superintendent of Work.
 - .2 Designated Health & Safety Site Representative.
 - .3 Subcontractors.
- .2 Conduct regularly scheduled tool box and safety meetings during the Work in conformance with Occupational Health and Safety regulations.
- .3 Keep documents on site.

1.11 HEALTH AND SAFETY PLAN

- .1 Prior to commencement of Work, develop written Health and Safety Plan specific to the Work. Implement, maintain, and enforce Plan for entire duration of Work and until final demobilization from site.
- .2 Health and Safety Plan shall include the following components:
 - .1 List of health risks and safety hazards identified by hazard assessment.
 - .2 Control measures used to mitigate risks and hazards identified.

- .3 On-site Contingency and Emergency Response Plan as specified below.
- .4 On-site Communication Plan as specified below.
- .5 Name of Contractor's designated Health & Safety Site Representative and information showing proof of his/her competence and reporting relationship in Contractor's company.
- .6 Names, competence and reporting relationship of other supervisory personnel used in the Work for occupational health and safety purposes.
- .3 On-site Contingency and Emergency Response Plan shall include:
 - .1 Operational procedures, evacuation measures and communication process to be implemented in the event of an emergency.
 - .2 Evacuation Plan: site and floor plan layouts showing escape routes, marshalling areas. Details on alarm notification methods, fire drills, location of firefighting equipment and other related data.
 - .3 Name, duties and responsibilities of persons designated as Emergency Warden(s) and deputies.
 - .4 Emergency Contacts: name and telephone number of officials from:
 - .1 General Contractor and subcontractors.
 - .2 Pertinent Federal and Provincial Departments and Authorities having jurisdiction.
 - .3 Local emergency resource organizations.
 - .5 Harmonize Plan with Facility's Emergency Response and Evacuation Plan. Departmental Representative will provide pertinent data including name of PCA and Facility Management contacts.
- .4 On-site Communication Plan:
 - .1 Procedures for sharing of work related safety information to workers and subcontractors, including emergency and evacuation measures.
 - .2 List of critical work activities to be communicated with Facility Manager which have a risk of endangering health and safety of Facility users.
- .5 Address all activities of the Work including those of subcontractors.
- .6 Review Health and Safety Plan regularly during the Work. Update as conditions warrant to address emerging risks and hazards, such as whenever new trade or subcontractor arrive at Work Site.
- .7 Departmental Representative will respond in writing, where deficiencies or concerns are noted and may request re-submission of the Plan with correction of deficiencies or concerns.
- .8 Post copy of the Plan, and updates, prominently on Work Site.

1.12 SAFETY SUPERVISION

- .1 Employ Health & Safety Site Representative responsible for daily supervision of health and safety of the Work.
- .2 Health & Safety Site Representative may be the Superintendent of the Work or other person designated by Contractor and shall be assigned the responsibility and authority to:

- .1 Implement, monitor and enforce daily compliance with health and safety requirements of the Work
- .2 Monitor and enforce Contractor's site-specific Health and Safety Plan.
- .3 Conduct site safety orientation session to persons granted access to Work Site.
- .4 Ensure that persons allowed site access are knowledgeable and trained in health and safety pertinent to their activities at the site or are escorted by a competent person while on the Work Site.
- .5 Stop the Work as deemed necessary for reasons of health and safety.
- .3 Health & Safety Site Representative must:
 - .1 Be qualified and competent person in occupational health and safety.
 - .2 Have site-related working experience specific to activities of the Work.
 - .3 Be on Work Site at all times during execution of the Work.
- .4 All supervisory personnel assigned to the Work shall also be competent persons.
- .5 Inspections:
 - .1 Conduct regularly scheduled safety inspections of the Work on a minimum bi-weekly basis. Record deficiencies and remedial action taken.
 - .2 Conduct Formal Inspections on a minimum monthly basis. Use standardized safety inspection forms. Distribute to subcontractors.
 - .3 Follow-up and ensure corrective measures are taken.
- .6 Cooperate with Facility's Occupational Health and Safety representative should one be designated by Departmental Representative.
- .7 Keep inspection reports and supervision related documentation on site.

1.13 TRAINING

- .1 Use only skilled workers on Work Site who are effectively trained in occupational health and safety procedures and practices pertinent to their assigned task.
- .2 Maintain employee records and evidence of training received. Make data available to Departmental Representative upon request.
- .3 When unforeseen or peculiar safety-related hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.14 MINIMUM SITE SAFETY RULES

- .1 Notwithstanding requirement to abide by federal and provincial health and safety regulations; ensure the following minimum safety rules are obeyed by persons granted access to Work Site:
 - .1 Wear appropriate PPE pertinent to the Work or assigned task; minimum being hard hat, safety footwear, safety glasses and hearing protection.
 - .2 Immediately report unsafe condition at site, near-miss accident, injury and damage.

- .3 Maintain site and storage areas in a tidy condition free of hazards causing injury.
- .4 Obey warning signs and safety tags.
- .2 Brief persons of disciplinary protocols to be taken for noncompliance. Post rules on site.

1.15 CORRECTION OF NON-COMPLIANCE

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

1.16 INCIDENT REPORTING

- .1 Investigate and report the following incidents to Departmental Representative:
 - .1 Incidents requiring notification to Provincial Department of Occupational Safety and Health, Workers Compensation Board or to other regulatory Agency.
 - .2 Medical aid injuries.
 - .3 Property damage in excess of \$10,000.00,
 - .4 Interruptions to Facility operations resulting in an operational lost to a Federal department in excess of \$5,000.00.
- .2 Submit report in writing.

1.17 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS).
- .2 Keep MSDS data sheets for all products delivered to site.
 - .1 Post on site.
 - .2 Submit copy to Departmental Representative.
 - .3 For interior work in an occupied Facility, post additional copy in one or more publicly accessible locations.

1.18 POWDER ACTUATED DEVICES

- .1 Use powder actuated fastening devices only after receipt of written permission from Departmental Representative.

1.19 CONFINED SPACES

- .1 Abide by occupational health and safety regulations regarding work in confined spaces.

- .2 Obtain an Entry Permit in accordance with Part XI of the Canada Occupational Health and Safety Regulations for entry into an existing identified confined space located at the Facility or premises of Work.
 - .1 Obtain permit from Facility Manager.
 - .2 Keep copy of permit issued.
- .3 Safety for Inspectors:
 - .1 Provide PPE and training to Departmental Representative and other persons who require entry into confined space to perform inspections.
 - .2 Be responsible for efficacy of equipment and safety of persons during their entry and occupancy in the confined space.

1.20 SITE RECORDS

- .1 Maintain on Work Site copy of safety related documentation and reports stipulated to be produced in compliance with Acts and Regulations of authorities having jurisdiction and of those documents specified herein. Upon request, make available to Departmental Representative or authorized Safety Officer for inspection.

1.21 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on Work Site in accordance with Acts and Regulations of Province having jurisdiction.
- .2 Post other documents as specified herein, including:
 - .1 Site specific Health and Safety Plan.
 - .2 WHMIS data sheets.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Waste Management and Disposal: Section 01 74 21.

1.2 DEFINITIONS

- .1 Hazardous Material: Product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to the environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .2 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .3 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.3 FIRES

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

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish and waste materials on site. Dispose in accordance with project waste management requirements specified in section 01 74 22.
- .2 Do not dispose of hazardous waste or volatile materials, such as mineral spirits, paints, thinners, oil or fuel into waterways, storm or sanitary sewers or waste landfill sites.
- .3 Dispose of hazardous waste in accordance with applicable federal and provincial laws, regulations, codes and guidelines.

1.5 DRAINAGE

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with governing regulations and requirements.
- .4 Provide control devices such as filter fabrics, sediment traps and settling ponds to control drainage and prevent erosion of adjacent lands. Maintain in good order for duration of work.

1.6 SITE AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties where indicated.

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

1.7 WORK ADJACENT TO WATERWAYS

- .1 Do not operate construction equipment in waterways.
- .2 Do not use waterway beds for borrow material without Departmental Representative's approval.
- .3 Do not dump excavated fill, waste material or debris in waterways.
- .4 At borrow sites, design and construct temporary crossings to minimize erosion to waterways in strict conformance with provincial environmental regulations.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- .7 Do not blast under water or 100 m of spawning beds.
- .8 Do not refuel any type of equipment within 100 meters of a water body. Maintain equipment in good working condition with no fluid leaks, loose hoses or fittings.

1.8 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authority's emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads and around entire construction site.
- .5 Have appropriate emergency spill response equipment and rapid clean-up kit on site located adjacent to hazardous materials storage area. Provide personal protective equipment required for clean-up.
- .6 Report, spills of petroleum and other hazardous materials as well as accidents having potential of polluting the environment to Federal and Provincial Department of the Environment.

- .1 Notify Departmental Representative and submit a written spill report to Departmental Representative within 24 hours of occurrence.

1.9 WILDLIFE PROTECTION

- .1 Should nests of migratory birds in wetlands be encountered during work, immediately notify Departmental Representative for directives to be followed.
 - .1 Do not disturb nest site and neighbouring vegetation until nesting is completed.
 - .2 Minimize work immediately adjacent to such areas until nesting is completed.
 - .3 Protect these areas by following recommendations of Canadian Wildlife Service.

END OF SECTION

Part 1 General

1.1 ABBREVIATIONS AND ACRONYMS

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

1.2 MATERIALS, EQUIPMENT AND METHODS

- .1 A:
 - .1 AC: acoustic.
 - .2 AC PAN: acoustic panel.
 - .3 ACU: acoustic unit ceiling.
 - .4 AFF: above finished floor.
 - .5 AC PLAS: acoustic plaster.
 - .6 ACT: acoustic tile.
 - .7 ACR CU LVR: acrylic cube louvre.
 - .8 ADH: adhesive.
 - .9 ADJ: adjustable.
 - .10 A/C: air conditioner.
 - .11 AL: aluminum.
 - .12 AB: anchor bolt.
 - .13 ANOD: anodized.
 - .14 ARCH: architecture.
 - .15 ARCH BLK: architectural block.
 - .16 AVB: air vapour barrier.
- .2 B:
 - .1 B: base.
 - .2 BEAST: benthic assessment of sediment.
 - .3 BH: bore hole.
 - .4 BL: bottom layer.
 - .5 BLK: block.
 - .6 BLKD: bulkhead.
 - .7 BM: beam.
 - .8 BOT: bottom.
 - .9 BMP: best management practice.
 - .10 B PL: base plate.
 - .11 BRG: bearing.
 - .12 BRK: brick.
 - .13 BSMT: basement.
 - .14 BTEX: benzene, toluene, ethylbenzene and xylenes.
 - .15 BUR: built-up roof.
- .3 C:
 - .1 CAL: caliper.
 - .2 CANTIL: cantilever.
 - .3 CB: catch basin.
 - .4 CC: centre to centre.

- .5 CCN: contemplated change notice.
- .6 CDF: controlled density fill.
- .7 CEC: Canadian Electrical Code.
- .8 CF: chair fabric.
- .9 CHAN: channel.
- .10 CHS: Canadian hydrographic service.
- .11 CJ: construction joint.
- .12 CL: centreline.
- .13 CK: cork.
- .14 CLG: ceiling.
- .15 CLR: clear.
- .16 COL: column.
- .17 CONC: concrete.
- .18 CONC BLK: concrete block.
- .19 CONC BRK: concrete brick.
- .20 CONT: continuous.
- .21 CONT J: control joint.
- .22 COMPL: complete.
- .23 CM: centimetre. (Nursery stock).
- .24 CPL: cement plaster.
- .25 CPM: critical path method.
- .26 CPT: carpet.
- .27 CPTT: carpet tile.
- .28 CT: ceramic tile.
- .29 CVT: conductive vinyl tile.
- .30 C/W: complete with.
- .4 D:
 - .1 D: deep.
 - .2 DD: dutch door.
 - .3 DEG: degree.
 - .4 DF: drinking fountain.
 - .5 DIA: diameter.
 - .6 DIM: dimension.
 - .7 DL: dead load.
 - .8 DMNT: demountable.
 - .9 DP: dampproofing.
 - .10 DR: door.
 - .11 DRP: drapery.
 - .12 DWL: dowel.
- .5 E:
 - .1 EA: each.
 - .2 EC: epoxy coating.
 - .3 ECF: engineered containment facility.
 - .4 EE: each end.
 - .5 EF: each face.
 - .6 EL: elevation.
 - .7 ELEC: electric.
 - .8 ELEV: elevator.

- .9 EM: expanded metal.
- .10 ENCL: enclosure.
- .11 EQ: equal.
- .12 EXH: exhaust.
- .13 EXIST: existing.
- .14 EXPJ: expansion joint.
- .15 EXP STRUCT: exposed structure.
- .16 EXT: exterior.
- .17 EW: each way.
- .6 F:
 - .1 FC: fuel contributed.
 - .2 FD: floor drain.
 - .3 FDN: foundation.
 - .4 FEAT W: feature wall.
 - .5 FEXT: fire extinguisher.
 - .6 FH: fire hose.
 - .7 FHC: fire hose cabinet.
 - .8 FHR: fire hose rack.
 - .9 FIN: finish.
 - .10 FIP: federal identity program.
 - .11 FL: floor.
 - .12 FLD: field.
 - .13 FLUOR: fluorescent.
 - .14 FR: frame.
 - .15 FRR: fire resistance rating.
 - .16 FTG: footing.
- .7 G:
 - .1 GALV: galvanized steel.
 - .2 GB: grab bar.
 - .3 GBD: gypsum board.
 - .4 GC: General Conditions.
 - .5 GF: ground floor.
 - .6 GFCI: ground fault circuit interrupter.
 - .7 GL: glass or glazing.
 - .8 GL BLK: glass block.
 - .9 GPC: gypsum plaster ceiling.
 - .10 GPW: gypsum plaster wall.
 - .11 GT: glass tile.
- .8 H:
 - .1 HB: hose bib.
 - .2 HC: hollow core.
 - .3 HCWD: hollow core wood door.
 - .4 HD: hand dryer.
 - .5 HDW: hardware.
 - .6 HDWD: hardwood.
 - .7 HM: hollow metal.
 - .8 HOR: horizontal.

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| .9 | HOR EF: horizontal each face. |
| .10 | HP: hydro pole. |
| .11 | HPA: Hamilton Port Authority. |
| .12 | HR: hour. |
| .13 | HRV: heat recovery ventilator. |
| .14 | HT: height. |
| .15 | HTR: heater. |
| .16 | HWT: hot water tank. |
| .17 | HYD: hydrant. |
| .9 | I: |
| .1 | ICF: insulated concrete formwork. |
| .2 | ID: inside diameter. |
| .3 | INS: insulation. |
| .4 | INTLK: interlock. |
| .10 | J: |
| .1 | JT: joint. |
| .11 | K: |
| .1 | KPL: kick plate. |
| .12 | L: |
| .1 | LAV: lavatory. |
| .2 | LDG: landing. |
| .3 | LG: long. |
| .4 | LINO: linoleum. |
| .5 | LL: live load. |
| .6 | LT: light. |
| .13 | M: |
| .1 | MAS: masonry. |
| .2 | MAS FL: masonry flashing. |
| .3 | MAX: maximum. |
| .4 | MBG: metal bar grating. |
| .5 | MCL: metal cube louvre. |
| .6 | MECH: mechanical. |
| .7 | MET: metal. |
| .8 | MET DK: metal deck. |
| .9 | MET FL: metal flashing. |
| .10 | MET GRID CLG: metal grid ceiling. |
| .11 | MET GRTG: metal grating. |
| .12 | MET LIN CLG: metal linear ceiling. |
| .13 | MET T PTN: metal toilet partition. |
| .14 | MH: maintenance hole. |
| .15 | MIN: minimum. |
| .16 | MLP: metal lath and plaster. |
| .17 | MO: masonry opening. |
| .18 | MR: marble. |
| .19 | MT: metal threshold. |

- .20 MWP: membrane waterproofing.
- .14 N:
- .1 NBC: national building code.
- .2 NF: near face.
- .3 NFC: national fire code.
- .4 NIC: not in contract.
- .5 NO: number.
- .6 NRC: noise reduction coefficient.
- .7 NRP: non removable pin.
- .8 NTS: not to scale.
- .15 O:
- .1 OBC: Ontario building code.
- .2 OC: on centre.
- .3 OD: outside diameter.
- .4 OPNG: opening.
- .5 OPR: operator.
- .6 OVHD: overhead.
- .7 OWSJ: open web steel joist.
- .16 P:
- .1 P: prefinished.
- .2 PAH: polynuclear aromatic hydrocarbons.
- .3 PARG: parging.
- .4 PCC: precast concrete.
- .5 PCT: porcelain ceramic tile.
- .6 PED ACS FLG: pedestal access flooring.
- .7 PF: panel fabric.
- .8 PL: plate.
- .9 PLAM: plastic laminate.
- .10 PLAS: plaster.
- .11 PLYWD: plywood.
- .12 PR: pair.
- .13 PREFAB: prefabricated.
- .14 PREFIN: prefinished.
- .15 PRFL: profile.
- .16 PT: paint.
- .17 PTD: paper towel dispenser.
- .18 PTN: partition.
- .19 PVC: polyvinyl chloride.
- .17 Q:
- .1 QTB: quarry tile base.
- .2 QTF: quarry tile floor.
- .3 QTR: quarry tile roof.
- .18 R:
- .1 R: radius.
- .2 RA: return air.

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- .3 RB: resilient base.
.4 RC: reinforced concrete.
.5 RCPT: receptacle.
.6 RD: roof drain.
.7 REINF: reinforced/reinforcing.
.8 REQD: required.
.9 REQT: requirement.
.10 RFT: rubber floor tile.
.11 RM: room.
.12 RO: rough opening.
.13 RP: radiant panel.
.14 RRS: recycled rubber sheet.
.15 RRT: recycled rubber tile.
.16 RSD: rolling steel door.
.17 RSF: rubber sheet flooring.
.18 RTU: roof top unit.
.19 RWL: rain water leader.
- .19 S:
- .1 SAN SEW: sanitary sewer.
.2 SCHED: schedule.
.3 SC: solid core.
.4 SCRNL: screen.
.5 SCWD: solid core wood door.
.6 SD: smoke developed.
.7 SDT: static dissipative tile.
.8 SECT: section.
.9 SH: sill height.
.10 SIM: similar.
.11 SL: sliding.
.12 SLR: sealer.
.13 SPEC: specification.
.14 SS: stainless steel.
.15 STD: standard.
.16 STL: steel.
.17 STL BM: steel beam.
.18 STC: sound transmission class.
.19 STL FL DK: steel floor deck.
.20 STL PL: steel plate.
.21 STN: stone.
.22 STR: structure or structural.
.23 ST SEW: storm sewer.
.24 S&U: stain and urethane.
.25 S&V: stain and varnish.
.26 SVT: solid vinyl tile.
- .20 T:
- .1 T: top.
.2 T&B: top and bottom.
.3 TCB: turbidity control plan.

- .4 TEL: telephone.
- .5 TER: terrazzo.
- .6 TERT: terrazzo tile.
- .7 THKNS: thickness.
- .8 THR: threshold.
- .9 TMPD: tempered.
- .10 TOPG: topping.
- .11 TRANSV: transverse.
- .12 TYP: typical.
- .21 U:
 - .1 U: urethane.
 - .2 UCUT: undercut.
 - .3 UGRD: underground.
 - .4 UNO: unless noted otherwise.
 - .5 UOS: unless otherwise specified.
 - .6 U/S: underside.
 - .7 UR: urinal.
- .22 V:
 - .1 VCF: vinyl coated fabric.
 - .2 VCT: vinyl composition tile.
 - .3 VERT: vertical.
 - .4 VERT B: vertical blinds.
 - .5 VERT EF: vertical each face.
 - .6 VSF: vinyl sheet flooring.
 - .7 VT: vinyl tile.
 - .8 VWC: vinyl wall covering.
- .23 W:
 - .1 WC: water closet.
 - .2 W-C: wall connectors.
 - .3 WD: wood.
 - .4 WDV: wood veneer.
 - .5 WH: wall hydrant.
 - .6 WHMIS: workplace hazardous materials information system.
 - .7 WP: waterproofing.
 - .8 WR: washroom.
 - .9 WSIB: workplace safety and insurance board.
 - .10 WT: weight.
 - .11 WTP: water treatment plant.

1.3 STANDARDS ORGANIZATIONS

- .1 Standards writing organizations:
 - .1 AA - Aluminum Association.
 - .2 ACPA - American Concrete Pipe Association.
 - .3 ANSI - American National Standards Institute.

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

1.4 FEDERAL GOVERNMENT DEPART- MENTS AND AGENGIES

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

1.5 PROVINCIAL GOVERNMENT DEPARTMENTS AND AGENGIES

1.6 UNITS OF MEASURE METRIC

- .1 The following abbreviations of units of measure are commonly found in the Project Manual:
 - .1 C: Celsius.
 - .2 cm: centimetre.
 - .3 kg: kilogram.
 - .4 kg/mü: kilogram per cubic metre.
 - .5 kN: kilonewton.
 - .6 kPa: kilopascals.
 - .7 kw: kilowatts.
 - .8 l/s: litre per second.
 - .9 m: metre.
 - .10 mü: cubic metre.
 - .11 mg/kg: milligrams per kilogram.
 - .12 mg/L: milligrams per litre.
 - .13 mm: millimetres.
 - .14 MPa: megapascal.
 - .15 NTU: nephelometric turbidity unit.
 - .16 ppm: parts per million.
 - .17 ug/L: micrograms per litre.
 - .18 ug/mü: micrograms per cubic metre.

1.7 UNITS OF MEASURE IMPERIAL

- .1 The following abbreviations of units of measure are commonly found in the Project Manual:
 - .1 F: Fahrenheit.
 - .2 ft: foot/feet.
 - .3 ga: gauge.
 - .4 gpm: gallons per minute.
 - .5 in: inches.
 - .6 lbs: pounds.

- .7 NTU: nephelometric turbidity unit.
- .8 psi: pounds-force per square inch.
- .9 ppm: parts per million.

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Give timely notice requesting inspection of Work designated for special tests, inspections or approvals by Departmental Representative or by inspection authorities having jurisdiction.
- .2 In accordance with the General Conditions, Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.
- .3 If Contractor covers, or permits to be covered, Work designated for special tests, inspections or approvals before such is made, uncover Work until particular inspections or tests have been fully and satisfactorily completed and until such time as Departmental Representative gives permission to proceed.
- .4 Pay costs to uncover and make good work disturbed by inspections and tests.

1.2 TESTING

- .1 Tests on materials, equipment and building systems as specified in various sections of the Specifications is the responsibility of the Contractor except where stipulated otherwise.
 - .1 Provide all necessary instruments, equipment and qualified personnel to perform tests.
- .2 At completion of tests, turn over 2 sets of fully documented tests reports to the Departmental Representative. Submit in accordance with Section 01 33 00.
 - .1 Obtain additional copies for inclusion of a complete set in each of the maintenance manuals specified in Section 01 78 00.
- .3 Unspecified tests may also be made by Departmental Representative, at the discretion of the Departmental Representative. The costs of these tests will be paid for by the Departmental Representative.
- .4 Where tests or inspections reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests and inspections incurred by Departmental Representative as required to verify acceptability of corrected work.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Departmental Representative may engage and pay for service of Independent Inspection and Testing Agencies for purpose of inspecting and testing portions of Work except for the following which remain part of Contractor's responsibilities:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of mechanical and electrical equipment and other building systems.
 - .4 Performance verification tests before building commissioning procedures commences.

- .5 Mill tests and certificates of compliance.
- .6 Tests as specified within various sections designated to be carried out by Contractor under the supervision of Departmental Representative.
- .2 Provide sufficient advance notice to Departmental Representative of time when the Work will be ready for testing by designated Testing Agency in order for Departmental Representative to make attendance arrangements with such Agency. When directed by Departmental Representative notify the Agency directly.
- .3 When specified or directed, submit Representative samples of materials, in required quantities, to Testing Agency for testing purposes. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .4 Provide labour and facilities to obtain, handle and deliver samples.
- .5 Provide sufficient space on site for Testing Agency's exclusive use to store equipment and cure test samples.
- .6 Employment of Independent Inspection and Testing Agencies by Departmental Representative does not relax responsibility to perform Work in accordance with Contract Documents.

1.4 ACCESS TO WORK

- .1 Facilitate Departmental Representative's access to Work. If part of Work is being fabricated at locations other than construction site, make preparations to allow access to such Work whenever it is in progress.
- .2 Furnish labour and facility to provide access to the work being inspected and tested.
- .3 Co-operate to facilitate such inspections and tests.

1.5 REJECTED WORK

- .1 Remove and replace defective Work, whether result of poor workmanship, use of defective or damaged products and whether incorporated in Work or not, which has been identified by Departmental Representative as failing to conform to Contract Documents.
- .2 Make good damages to new and existing construction and finishes resulting from removal or replacement of defective work.

1.6 MOCK-UPS

- .1 Prepare mock-ups of certain work as specified in various sections of the Specifications. Include in each mock-up all related work components representative of final assembly.
- .2 Construct in locations acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.
- .6 Dismantle and remove mock-up when directed by Departmental Representative, unless approval is given for mock-up to remain as part of the Work.

END OF SECTION

Part 1 General

1.1 SITE ACCESS AND PARKING

- .1 The Departmental Representative will designate Contractor's access to project site as well as parking facilities for equipment and workers.
- .2 The Contractor is advised that while parking facilities for his workers and subcontractors will be on property, such parking facilities may be remote from the actual site of the work. In any case, follow all instructions from the Departmental Representative in regard to parking facilities.
- .3 Maintain existing roads and parking areas at site, where used by Contractor, for duration of contract.
 - .1 Keep clean and free of mud and dirt by washing on a regular basis.
 - .2 Provide snow removal in areas located within construction site or enclosed by work.
 - .3 Make good and repair damage resulting from Contractor's use of existing roads, asphalted areas and lawns on site.

1.2 BUILDING ACCESS

- .1 Use only access doors, and circulation routes and elevators within building as designated by Departmental Representative to access interior work.

1.3 MATERIAL STORAGE

- .1 Locate site storage trailers where directed by Departmental Representative. Place in location of least interference with existing Facility operations.
- .2 Material storage space on site is limited. Coordinate delivery to minimize storage period on site before being needed for incorporation into work.
- .3 Make arrangements elsewhere in the city as deemed required and pay all costs for storage of materials not ready for incorporation into work.

1.4 INTERIOR HOARDING

- .1 Erect hoarding inside building to isolate construction areas and protect occupants for duration of work.
- .2 Construct hoarding as follows:
 - .1 Height: to underside of floor or roof above.
 - .2 Framing type: 92mm steel stud spaced at 610 mm on centre.
 - .3 Scribed to underside and profile of ceiling above.
 - .4 Fill stud cavity with acoustic batt.
 - .5 Covering: 13 mm thick gypsum board sheathing both sides. Taped and filled on one (1) side.
 - .6 Finish: Prime plus one coat of 100% acrylic paint: public view only.
 - .7 Apply acrylic sealant to abutting surfaces.

- .8 Access Door and Frame: one (1) steel 914x2134 mm door and frame sound sealed , dust tight and lockable.

1.5 INTERIOR DUST CONTROL AND DUST BARRIERS

- .1 Control creation and spread of dust and dirt to building interior and in particular to areas within premises still under use by occupants.
- .2 Develop and implement a dust control plan, addressing effective measures to carry out work with least amount of dust being created and propagated.
 - .1 Carefully evaluate the type of work to be undertaken and the physical layout of each work area on site.
 - .2 Provide specifically tailored strategy for each work area.
 - .3 Pre-determine location and placement of dust barriers to confine resulting dust to immediate work area.
 - .4 Inform Departmental Representative of the proposed dust control measures to be followed at each work area and for each major dust generating activities. Obtain Departmental Representative's approval before proceeding with work.
- .3 Dust control plan to incorporate as a minimum the following dust protection and cleaning requirements:
 - .1 Erect dustproof partitions completely around work area to fully isolate construction from other parts of the building.
 - .2 Construct dust partitions as follows:
 - .1 Use 10 mil polyethylene installed and sealed tightly to abutting walls, ceilings and floor with continuous duct tape along all edges and seams. Support in position with 38 x 89 wood framing at 400 mm o.c. Locate seams only at framing members and overlap sheeting by minimum of 150 mm.
 - .2 Use 13 mm thick plywood installed to steel stud framing spaced at 400 mm o.c. for areas located in public and corridors in use by occupants
 - .1 Erect from floor to underside of ceiling above, sheeting applied to occupied side of partition..
 - .2 Scribe, cut and fit sheathing tight to shape of structural steel, deck profile and to other obstructions in ceiling space and abutting walls.
 - .3 Use compressible neoprene gaskets around perimeter of partition and at all protrusions to achieve airtight construction.
 - .4 Where partition is exposed to public view, tape and finish drywall joints and paint surface to color approved by the Departmental Representative.
 - .3 Provide a "dust tight" and lockable access door(s) within dust partition or between rooms for worker entry into work area. This is of particular importance for situations where excessive dust will be generated.
 - .4 Provide additional dust barriers, placed tightly to underside of the floor/roof deck above, in locations where existing walls are used as part of the dust barrier system but simply terminate at the finished ceiling level resulting in an open space above, or other similar condition, permitting dust to migrate beyond the construction areas.
 - .5 Make all dust barriers airtight, effectively blocking and stopping all dust migration.

- .6 Inspect dust barriers at various intervals during each work shift. Immediately fix tears, unsealed edges and maintain barriers effectively sealed for the entire work duration.
- .7 Shut down existing ventilation system feeding construction space, or disconnect and seal-off supply and return air ducts to stop dust from contaminating other areas.
- .8 Immediately clean areas in use by occupants and public contaminated by work.
 - .1 Vacuum carpets, wash floors and walls. Remove accumulated dust from all surfaces. Clean and remove smears, scuffs and marks.
- .4 Meager attempts at controlling dust will not be tolerated. Failure to provide effective dust control during work and to perform satisfactory cleaning thereafter will result in Departmental Representative to proceed and obtain a separate cleaning service agency to perform cleaning to tenant's satisfaction with cost for such services being charged against this Contract.
- .5 Obtain Departmental Representative's approval before erecting any dust partitions simply to underside of finish ceiling.
- .6 Construction of dust barriers, enclosures and placement of temporary protective devices to be performed during Facility non-operational off-hour periods.

1.6 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Sanitary facilities are available at the site and may be used by Contractor's work force. Make arrangements for the use of such facilities through the Departmental Representative.
- .4 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Departmental Representative.

1.7 POWER

- .1 Power supply is available and will be provided for construction usage at no cost.
 - .1 Make arrangements for the use of such services through the Departmental Representative.
 - .2 Departmental Representative will designate and approve each location of existing power source to which connections can be made to obtain temporary power service.
 - .3 Connect to existing power supply in accordance with CSA C22.1-12, Canadian Electrical Code.
- .2 Provide and pay all costs to supply and install temporary cabling, panel boards, switching devices and other equipment as required to connect into power source, provide adequate ground fault protection and extend power supply from existing source to work areas. Perform work and make all connections in accordance with the CSA C22.1-12 Canadian Electrical Code, in compliance with the federal and provincial Occupational Health and Safety Regulations as specified in section 01 35 29.

- .3 Provide and maintain temporary lighting to conduct work. Ensure illumination level is not less than 162 lx in all locations.
- .4 Electrical power and lighting systems installed under this Contract can be used for construction requirements provided that guarantees are not affected thereby. Make good damage. Replace lamps which have been used over period of 3 months.

1.8 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in rigid, secure and safe manner in accordance with CSA Z797-09, Code of Practice for Access Scaffold.
- .2 Erect scaffolding independent of walls. Remove when no longer required.

1.9 HEATING AND VENTILATING

- .1 Supply, install and pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Use of direct-fired heaters discharging waste products into work areas will not be permitted.
- .2 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of work.
 - .2 Protect work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Maintain minimum temperature of 10 degrees C, or higher where specified, as soon as finishing work is commenced and maintain until acceptance of structure by Departmental Representative.
 - .1 Maintain ambient temperature and humidity levels as required for comfort of office personnel.
- .4 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .5 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.

- .3 Prevent abuse of services.
- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.
- .6 Submit bid assuming existing equipment and systems will not be used for temporary heating and ventilating.
- .7 Upon acceptance of bid, Departmental Representative may permit use of permanent system providing agreement can be reached on:
 - .1 Conditions of use, special equipment, protection and maintenance.
 - .2 Saving on Contract price.
 - .3 Provisions relating to warranties on equipment.

1.10 CONSTRUCTION SIGN AND NOTICES

- .1 Contractor or subcontractor advertisement signboards are not permitted on site.
- .2 Safety and Instruction Signs and Notices:
 - .1 Signs and notices for safety and instruction shall be in both official languages or commonly understood graphic symbols conforming to CAN/CSA-Z321-96(R2006).
- .3 Maintenance and Disposal of Site Signs:
 - .1 Maintain approved signs and notices in good condition for duration of project and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.11 REMOVAL OF TEMPORARY FACILITIES

- .1 Remove temporary facilities from site when directed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Use new material and equipment unless otherwise specified.
- .2 Within seven (7) days of written request by Departmental Representative, submit following information for any materials and products proposed for supply:
 - .1 Name and address of manufacturer.
 - .2 Trade name, model and catalogue number.
 - .3 Performance, descriptive and test data.
 - .4 Compliance to specified standards.
 - .5 Manufacturer's installation or application instructions.
 - .6 Evidence of arrangements to procure.
 - .7 Evidence of manufacturer delivery problems or unforeseen delays.
- .3 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.
- .4 Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified.
- .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.

1.2 PRODUCT QUALITY

- .1 Contractor shall be solely responsible for submitting relevant technical data and independent test reports to confirm whether a product or system proposed for use meets contract requirements and specified standards.
- .2 Final decision as to whether a product or system meets contract requirements rest solely with the Departmental Representative in accordance with the General Conditions of the Contract.

1.3 ACCEPTABLE MATERIALS AND ALTERNATIVES

- .1 Acceptable Materials: When materials specified include trade names or trade marks or manufacturer's or supplier's name as part of the material description, select and only use one of the names listed for incorporation into the Work.
- .2 Alternative Materials: Submission of alternative materials to trade names or manufacturer's names specified must be done during the bidding period following procedures indicated in the Instructions to Bidders.
- .3 Substitutions: After contract award, substitution of a specified material will be dealt with as a change to the Work in accordance with the General Conditions of the Contract.

1.4 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods to be used. Do not rely on labels or enclosure provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing of any conflict between these specifications and manufacturers instructions, so that Departmental Representative will designate which document is to be followed.

1.5 AVAILABILITY

- .1 Immediately notify Departmental Representative in writing of unforeseen or unanticipated material delivery problems by manufacturer. Provide support documentation as per clause 1.1.2 above.

1.6 WORKMANSHIP

- .1 Ensure quality of work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed.
- .2 Remove unsuitable or incompetent workers from site as stipulated in the General Conditions of the Contract.
- .3 Ensure cooperation of workers in laying out work. Maintain efficient and continuous supervision on site at all times.
- .4 Coordinate work between trades and subcontractors. See section 01 14 10 in this regard.
- .5 Coordinate placement of openings, sleeves and accessories.

1.7 FASTENINGS - GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non- corrosive fasteners, anchors and spacers for securing exterior work and in humid areas.
- .2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage. Wood or organic material plugs not acceptable.
- .3 Keep exposed fastenings to minimum, space evenly and lay out neatly.
- .4 Fastenings which cause spalling or cracking of material to which anchorage is made, are not acceptable.
- .5 Do not use explosive actuated fastening devices unless approved by Departmental Representative. See section on Health and Safety Requirements in this regard.

1.8 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.
- .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 and, use resilient washers with stainless steel.

1.9 STORAGE, HANDLING AND PROTECTION

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

1.10 CONSTRUCTION EQUIPMENT AND PLANT

- .1 On request, prove to the satisfaction of Departmental Representative that the construction equipment and plant are adequate to manufacture, transport, place and finish work to quality and production rates specified. If inadequate, replace or provide additional equipment or plant as directed.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .3 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

1.2 MATERIALS

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

1.3 CLEANING DURING CONSTRUCTION

- .1 Maintain work areas in a tidy condition, free from accumulations of waste material and debris. Clean areas on a daily basis.
- .2 Keep building entrances, corridors, stairwells and tenant occupied areas of building in a clean dust free condition at all times. Conduct thorough cleaning of these areas at end of each work shift when used by workers or affected by the Work.
- .3 Provide on-site steel dump containers for collection of waste materials and debris.
- .4 Use separate collection bins, clearly marked as to purpose, for source separation and recycling of waste and debris in accordance with waste management requirements specified.
- .5 Remove waste materials, and debris from site on a daily basis.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .7 Provide dust barriers, dividers, seals on doors and employ other dust control measures as required to ensure that dust and dirt, generated by work, are not transmitted to existing areas of building. Should dust migrate into tenant occupied and public areas of building, employ such means as may be necessary to immediately clean all contaminated surfaces to the satisfaction of the Departmental Representative.
 - .1 See Section 01 50 00 for requirements on dust control and for erection of dust partitions.
- .8 Immediately clean all dust, dirt, smears, scuffs and soiled surfaces in lobbies, corridors, stairwells and within tenant occupied areas resulting from the Work.
 - .1 Perform cleaning, dusting and washing operations, carpet vacuuming (including shampooing if deemed required by Departmental Representative) and floor washing as necessary to thoroughly clean all soiled surfaces.

- .9 Remove snow and ice from access doors used by workforce.

1.4 FINAL CLEANING

- .1 In preparation for acceptance of the completed work perform final cleaning.
- .2 Remove grease, dust, dirt, stains, labels, fingerprints, marks and other foreign materials, from interior and exterior finished surfaces. Clean and polish surfaces including glass, mirrors, hardware, wall tile, stainless steel, chrome, baked enamel, plastic laminate, mechanical and electrical fixtures.
- .3 Replace items with broken pieces, scratches or disfigured.
- .4 Clean lighting reflectors, lenses, and other lighting surfaces.
- .5 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .6 Wax, seal, shampoo or prepare floor finishes as recommended by manufacturer.
- .7 Inspect finishes, fitments and equipment. Ensure specified workmanship and operation.
- .8 Broom clean and wash exterior paved surfaces and walks; rake clean other surfaces of grounds.
- .9 Remove debris and surplus materials from crawl areas, roof areas and other accessible concealed spaces.
- .10 Clean equipment, washroom and kitchen fixtures to a sanitary condition. Replace filters of mechanical equipment.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

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

1.2 WASTE MANAGEMENT

- .1 Incorporate environmental and sustainable practises in managing waste resulting from work.
- .2 Divert as much waste as possible from landfill.
- .3 Coordinate work of subtrades and subcontractors to ensure all possible waste reduction and recycling opportunities are taken. Follow waste management requirements specified in trade sections of the Specifications.
- .4 Reduce waste during installation of new materials. Undertake practices which will optimize full use of materials and minimize waste.
- .5 Develop innovative procedures to reduce quantity of waste generated by construction such as by delivering materials to site with minimal packaging etc.
- .6 Provide on-site facilities to collect, handle and store anticipated quantities of reusable, salvageable and recyclable materials.
- .7 During demolition and removal work separate materials and equipment at source, carefully dismantling, labelling and stockpiling alike items for the following purposes:
 - .1 Reinstallation into the work where indicated.
 - .2 Salvaging reusable items not needed in project which Contractor may sell to other parties.
 - .3 Sending as many items as possible to locally available recycling facility.
 - .4 Segregating remaining waste and debris into various individual waste categories for disposal in a "non-mixed state" as recommended by waste processing/landfill sites.
- .8 Isolate product packaging and delivery containers from general waste stream. Send to recycling facility or return to supplier/manufacturer.
- .9 Send leftover material resulting from installation work for recycling whenever possible.
- .10 Establish methods whereby hazardous and toxic materials, and their containers used on site are properly handled, stored and disposed in accordance with applicable federal, provincial and municipal laws and regulations.

1.3 DISPOSAL REQUIREMENTS

- .1 Burying or burning of rubbish and waste materials is prohibited.

- .2 Disposal of volatile materials, mineral spirits, oil, paint, and other hazardous materials into waterways, storm, or sanitary sewers is prohibited.
- .3 Dispose of waste only at approved waste processing facility or landfill sites approved by authority having jurisdiction.
- .4 Contact the authority having jurisdiction prior to commencement of work, to determine what, if any, demolition and construction waste materials have been banned from disposal in landfills and at transfer stations. Take appropriate action to isolate such banned materials at site of work and dispose in strict accordance with provincial and municipal regulations.
- .5 Transport and dispose of waste intended for waste processing plant or landfill facility in separated condition and to Operator's rules and recommendations in support of their effort to recycle, reduce and divert certain waste stream from general landfill.
- .6 Collect, bundle and transport salvaged materials to be recycled in separated categories and condition as directed by recycling facility. Ship materials only to approved recycling facilities.
- .7 Sale of salvaged items by Contractor to other parties not permitted on site.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Administrative procedures preceding inspection and acceptance of Work by Departmental Representative.

1.2 RELATED SECTIONS

- .1 Section 01 78 00: Closeout Submittals.

1.3 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Coordinate and perform, in concert with subcontractors, an inspection and check of all Work. Identify and correct deficiencies, defects, repairs and perform outstanding items as required to complete work in conformance with Contract Documents.
 - .1 Notify Departmental Representative in writing when deficiencies from Contractor's inspection have been rectified and that Work is deemed to be complete and ready for Departmental Representative's inspection of the completed work.
- .2 Departmental Representative's Inspection: Accompany Departmental Representative during all substantial and final inspections of the Work.
 - .1 Address defects, faults and outstanding items of work identified by such inspections.
 - .2 Advise Departmental Representative when all deficiencies identified have been rectified.
- .3 Note that Departmental Representative will not issue a Certificate of Substantial Performance of the work until such time that Contractor performs following work and turns over the specified documents:
 - .1 Project record as-built documents;
 - .2 Final Operations and Maintenance manuals;
 - .3 Maintenance materials, parts and tools;
 - .4 Compliance certificates from applicable authorities;
 - .5 Reports resulting from designated tests;
 - .6 Demonstration and training complete with user manuals;
 - .7 Manufacturer's Guarantee certificates.
 - .8 Testing, adjusting and balancing of equipment and systems complete with submission of test reports.
 - .9 Commissioning of equipment and systems specified.
- .4 Correct all discrepancies before Departmental Representative will issue the Certificate of Completion.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Project Record Documents.
- .2 Operations and Maintenance data.

1.2 RELATED SECTIONS

- .1 Section 01 79 00: Demonstration and Training.

1.3 PROJECT RECORD DOCUMENTS

- .1 Departmental Representative will provide two (2) white print sets of contract drawings and two (2) copies of Specifications Manual specifically for "As-Built" purposes.
- .2 Maintain at site one set of the contract drawings and specifications to record actual As-Built site conditions.
- .3 Maintain up-to-date, real time as-built drawings and specifications in good condition and make available for inspection by the Departmental Representative upon request.
- .4 As-Built Drawings:
 - .1 Record changes in red ink on the prints. Mark only on one set of prints and at completion of work, neatly transfer notations to second set (also by use of red ink).
 - .2 Submit both sets to Departmental Representative prior to application for Certificate of Substantial Performance.
 - .3 Stamp all drawings with "As-Built". Label and place Contractor's signature and date.
 - .4 Show all modifications, substitutions and deviations from what is shown on the contract drawings.
 - .5 Record following information:
 - .1 Horizontal and vertical location of exterior underground utilities and appurtenances referenced to permanent surface improvements.
 - .2 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure;
 - .3 Field changes of dimension and detail;
 - .4 Location of all capped or terminated services and utilities.
 - .5 Chases for mechanical, electrical and other services;
 - .6 Ceiling and floor elevations;
 - .7 Reflected ceiling plan condition showing finished layout of all ceiling-mounted services and devices;
 - .8 Plumbing, heating, air conditioning and ventilation, sprinkler and electrical service installation locations; all to be dimensioned and referenced to building columns or load bearing walls;

- .9 All structural steel installations to be fully dimensioned;
 - .10 All design elevations, sections, floor plans and details dimensioned and marked-up to consistently report finished installation conditions;
 - .11 Any details produced in the course of the contract by the Departmental Representative to supplement or to change existing design drawings;
 - .12 All change orders issued over the course of the contract must be documented on the finished As-Built documents, accurately and consistently depicting the changed condition as it applies to all affected drawing details.
- .5 As-Built Specifications: legibly mark in red each item to record actual construction, including:
- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly items substituted from that specified.
 - .2 Changes made by Addenda and Change Orders.
 - .3 Mark up both copies of specifications; stamp "As-Built", sign and date similarly to drawings as per above clause.
- .6 Maintain As-Built documents current as the contract progresses. Departmental Representative will conduct reviews and inspections of the documents on a regular basis..

1.4 REVIEWED SHOP DRAWINGS

- .1 Provide a complete set of all shop drawings reviewed for project to incorporate into each copy of the Operations and Maintenance Manuals.
- .2 Submit full sets at same time and as part of the contents of the Operation and Maintenance Manuals specified.

1.5 UPDATING OF DIGITAL DRAWINGS

- .1 Obtain and pay for the services of a qualified drafting firm to update the digital files which were used to produce the contract drawings.
 - .1 Update the digital drawing files with the same As-Built information as specified for the paper As-Built drawings.
 - .2 Supply of digital documents does not replace the requirement to provide marked-up white prints specified above.
- .2 The Departmental Representative will provide a copy of the digital drawing files.
- .3 Incorporate the as-built changes to the digital drawings by following the standards specified in the latest version of the PCA National CADD Standard. A copy of this manual will be provided by the Departmental Representative.
- .4 Make revisions to electronic files found to be in non-conformance with the PCA National CADD Standard as directed by Departmental Representative.
- .5 In regard to updating the digital files to reflect changes resulting from Change Orders, the change in cost of completing the As-Built documentation of changes is to be included in the amount for each Change Order issued. The amount included will constitute only the increase or decrease in CADD related costs resulting directly from the change. In determining the cost difference, full

consideration will be given to the fact that other clauses of this section require As-Built CADD updates to the drawings irrespective of any Change Orders.

- .6 Deliver the digital As-Built information in same format and sequence as the contract drawings and specifications.
 - .1 Submit on PCA encrypted USB.
 - .2 Provide 1 full set of paper plots.
 - .3 Submit the digital As-Built at the same time as the marked-up paper white prints.

1.6 OPERATIONS & MAINTENANCE MANUAL

- .1 O&M Manual - Definition: an organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of the specifications.
- .2 Manual Language: final manuals to be in English languages.
- .3 Number of copies required:
 - .1 Submit 2 interim copies of the manual for review and inspection by Departmental Representative. Make revisions and additions as directed and resubmit.
 - .2 Upon review and acceptance by Departmental Representative, submit 3 4 final copies. Interim copies are not to be considered as part of the final copies unless they have been fully revised and are identical to the final approved version.
- .4 Submission Date: submit complete operation and maintenance manual to Departmental Representative three (3) weeks prior to application for Certificate of Substantial Performance of the work.
- .5 Binding:
 - .1 Assemble, coordinate, bind and index required data into Operation and Maintenance Manual.
 - .2 Use vinyl, hard covered, 3 "D" ring binders, loose leaf, sized for 215 x 280 mm paper, with spine pocket.
 - .3 Where multiple binders are needed, correlate data into related consistent groupings.
 - .4 Identify contents of each binder on spine.
 - .5 Organize and divide data following same numerical system as the section numbers of the Specification Manual.
 - .6 Dividers: separate each section by use of cardboard dividers and labels. Provide tabbed fly leaf for each individual product and system and give description of product or component.
 - .7 Type lists and notes. Do not hand write.
 - .8 Drawings, diagrams and manufacturers' literature must be legible. Provide with reinforced, punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .6 Manual Contents:
 - .1 Cover sheet containing:
 - .1 Date submitted.

- .2 Project title, location and project number.
 - .3 Names and addresses of Contractor, and all Sub-Contractors.
- .2 Table of Contents: provide full table of contents in each binder(s), clearly indicate which contents are in each binder.
- .3 List of maintenance materials.
- .4 List of spare parts.
- .5 List of special tools.
- .6 Original or certified copy of warranties and product guarantees.
- .7 Copy of approval documents and certificates issued by Inspection Authorities.
- .8 Copy of reports and test results performed by Contractor as specified.
- .9 Product Information (PI Data) on materials, equipment and systems as specified in various sections of the specifications. Data to include:
 - .1 List of equipment including manufacturer's name, supplier, local source of supplies and service depot(s). Provide full addresses and telephone numbers.
 - .2 Nameplate information including equipment number, make, size, capacity, model number and serial number.
 - .3 Parts list.
 - .4 Installation details.
 - .5 Operating instructions.
 - .6 Maintenance instructions for equipment.
 - .7 Maintenance instructions for finishes.
- .7 Shop drawings:
 - .1 Include complete set of reviewed shop drawings into each copy of the operations and maintenance manual.
 - .2 Fold and bind material professionally in a manner that corresponds with the specification section numbering system.
 - .3 When large quantity of data is submitted, place into separate binders of same size as O&M binders.
- .8 Equipment and Systems Data: the following list indicates the type of data and extent of information required to be included for each item of equipment and for each system:
 - .1 Description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- .6 Servicing and lubrication schedule, and list of lubricants required.
- .7 Manufacturer's printed operation and maintenance instructions.
- .8 Sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports.
- .15 Additional requirements as specified in individual specification sections.
- .9 Materials and Finishes Maintenance Data:
 - .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
 - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .4 Additional Requirements: as specified in individual specifications sections.

1.7 SPARE PARTS, TOOLS AND MAINTENANCE MATERIALS

- .1 Provide spare parts, special tools and extra materials for maintenance purposes in quantities specified in individual specification sections.
- .2 Tag all items with associated function or equipment.
- .3 Provide items of same manufacture and quality as items in Work.
- .4 Deliver to site in well packaged condition. Store in location as directed by Departmental Representative.
- .5 Clearly mark as to contents indicating:
 - .1 Part number.
 - .2 Identification of equipment or system for which parts are applicable.
 - .3 Installation instructions or intended use as applicable.
 - .4 Name, address and telephone number of nearest suppliers.
- .6 Prepare and submit complete inventory list of items supplied. Include list within Maintenance Manual.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Operations and Maintenance Manual: Section 01 78 00.

1.2 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel prior to date of final inspection.
- .2 Departmental Representative will provide a list of Owner's personnel to receive instructions,
- .3 Cooperate with Departmental Representative in coordinating time and attendance of Owner's personnel with manufacturer's training Representative(s).

1.3 QUALITY CONTROL

- .1 Ensure that only personnel from own forces, Subcontractors or Suppliers competent and fully knowledgeable in the particular material component, equipment or system installation are used to provide training and demonstrations.
- .2 When specified in individual Sections, obtain the manufacturers authorized Representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.
- .3 Upon request, provide evidence to Departmental Representative of individual Trainor's knowledge and qualifications.

1.4 SUBMITTALS

- .1 Submit schedule of time, date and complete list of equipment and systems for which demonstration and training sessions will be provided. Submit schedule a minimum of two (2) weeks prior to designated dates, for Departmental Representative's approval.
- .2 Submit report within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed. Provide time and date of when each demonstration was actually given, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

- .1 Prior to carrying out demonstration and training, ensure that equipment has been inspected and tested, is fully operational, has been performance verified and TAB has been carried out.
- .2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.6 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.

- .2 Verify that designated personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

- .1 Include the following items within the demonstration and training:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each of equipment.
 - .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
 - .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.
 - .5 Provide other specific training and instructions as specified in trade sections.

1.8 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Observe the allocated time period specified in trade sections. Provide additional time when required to ensure all personnel fully understand all aspects of the information and instructions being provided. Allow for questions by participants.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Removal of designated construction.
- .2 Storage of removed materials and Disposal of materials.
- .3 Deconstruction and removal of entire buildings to achieve 75% waste diversion from landfill.

1.2 RELATED SECTIONS

- .1 Section 01 74 20 - Waste Management and Disposal

1.3 DEFINITIONS

- .1 Selective Deconstruction: Disassembly and removal of selected portions of building or structure.
- .2 Salvage: Removal of disassembled building materials for reuse or recycling.
- .3 Demolish: Remove and legally dispose of off-site.

1.4 ALTERATION PROJECT PROCEDURE

- .1 Materials: As specified in Product sections; match existing Products and work for patching and extending work.
- .2 Employ skilled and experienced installer to perform alteration work.
- .3 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .4 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to specified condition.
- .5 Where new work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .6 When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Consultant for review.
- .7 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition; to Consultant for review.
- .8 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .9 Unless otherwise indicated, deconstruction waste becomes property of demolition contractor.

1.5 PROJECT OBJECTIVES

- .1 Selective dismantling of building components for high value reuse and recycling. This includes non-structural and structural reuse/recycling of material such as windows, doors, appliances, mechanical equipment, electrical equipment, and dismantling of the structural fabric of a building e.g. building frame, roof system and walls, and floors.

- .2 Divert a minimum of 75% (by dollar value) of building and demolition material from landfill. Refer to 01 74 20 (Waste Management and Disposal)
- .3 Unless noted otherwise, the demolition contractor has sole discretion as to which building materials are to be recycled or disposed of. A schedule of demolition materials for recovery and turn over to the Owner is provided at the end of these specifications.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: Schedule work to requirements of Section 01 31 00.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submittal Procedures.
- .2 Submit deconstruction plan prior to start of work, include the following information:
 - .1 Detailed sequence of deconstruction and removal work, with starting and ending dates for each activity.
 - .2 Interruption of utility services. Indicate how long utility services will be interrupted.
 - .3 Coordination for shutoff, capping, and continuation of utility services.
 - .4 Use of elevator and stairs.
 - .5 Locations of proposed dust-control and noise-control temporary partitions and means of egress.
 - .6 Means of protection for items to remain and items in path of material removal from building
- .3 Deconstruction Photographic Documentation: Document general condition of materials to be salvaged prior to removal.

1.8 QUALITY ASSURANCE

- .1 Deconstruction Firm Qualifications: Companies experienced and specializing in performing the Work of this Section with documented experience in similar types of deconstruction work.
- .2 Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- .3 Comply with noise and dust regulations of authorities having jurisdiction.
- .4 Pre-Deconstruction Conference: Conduct conference at Project site. Review methods and procedures related to deconstruction including, but not limited to, the following:
 - .1 Inspect and discuss condition of building to be deconstructed.
 - .2 Review structural load limitations of existing structure.
 - .3 Review and finalize deconstruction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
 - .4 Review requirements of work performed by other trades that rely on substrates exposed by deconstruction operations.
 - .5 Review areas where existing construction is to remain and requires protection.
 - .6 Review method for removing materials from the site.
 - .7 Review staging area for materials on the site.

1.9 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Closeout Submittals.
- .2 Section 01 74 20: Waste Management and Disposal - Schedules

1.10 REGULATORY REQUIREMENTS

- .1 Conform to applicable federal, provincial, and municipal codes for demolition work, dust control, products requiring electrical disconnection.
- .2 Obtain required permits from authorities. Pay for all permits, fees, and taxes associated with demolition.
- .3 Do not close or obstruct egress width to any building or site exit.
- .4 Do not disable or disrupt building fire or life safety systems without three (3) days prior written notice to Owner.
- .5 Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.11 PROJECT CONDITIONS

- .1 Conduct demolition to minimize interference with adjacent and occupied building areas.
- .2 Cease operations immediately if structure appears to be in danger and notify Consultant. Do not resume operations until directed.
- .3 The encounter of Hazardous Materials should be anticipated during demolition work. Refer to Owner provided Hazmat report.
- .4 Unless noted otherwise, all existing utilities shall remain in service and protected against damage during deconstruction operations.
- .5 Maintain fire-protection facilities in service during deconstruction operations.

Part 2 Products

2.1 Not Used.

Part 3 Execution

3.1 PREPARATION

- .1 Protect existing materials and constructions which are not to be demolished.
- .2 Prevent movement of structure; provide bracing and shoring.
- .3 Notify affected utility companies before starting work and comply with their requirements.
- .4 Mark location and termination of utilities.
- .5 Provide appropriate temporary signage including signage for exit or building egress.

3.2 DEMOLITION

- .1 Demolish in an orderly and careful manner.

- .2 Disconnect, remove, and identify designated utilities within demolition areas.
- .3 Remove demolished materials from site except where specifically noted otherwise.
- .4 Refer to drawings for scope and additional information regarding demolition.
- .5 Protect existing structures outside of the contract boundary and supporting structural members.
- .6 Remove demolished materials from site except where specifically noted otherwise.
- .7 Remove materials as work progresses. Upon completion of Work, leave areas in clean condition.
- .8 Do not burn or bury materials on site.
- .9 Remove temporary Work.

3.3 DEMOLITION OBJECTIVES AND SCOPE

- .1 Demolition Objectives and Scope
 - .1 Objectives
 - .1 Good practice recovery of building material value.
 - .2 Identify how much of the non-structural parts building will be re-used in what way. Identify how much of all building material (non-structural and structural) will be recycled (not including use as landfill cover). Identify the process for reusing and recycling material, who will be the end user, and how the material will be used.
 - .3 Refer to 01 74 20 Waste Managing and Disposal for documentation methods.
 - .2 Scope
 - .1 Architectural Removals
 - .1 Refer to drawings for architectural selective demolition scope.
 - .2 The Contractor shall obtain and pay for all permits, fees, and taxes associated with the architectural demolition and allow for the same in their Tender submission/quotation.
 - .3 The Contractor shall supply all materials, equipment, and labour necessary for the demolition of the existing architectural systems as outlined in these specifications and/or as found on-site
 - .2 Mechanical Removals
 - .1 Refer to drawings for mechanical selective demolition scope.
 - .2 The Contractor shall obtain and pay for all permits, fees, and taxes associated with the Mechanical demolition and allow for the same in their Tender submission/quotation.
 - .3 The Contractor shall supply all materials, equipment, and labour necessary for the demolition of the existing Mechanical systems as outlined in these specifications and/or as found on-site
 - .4 Coordinate work and removal of existing equipment with the Owner's representative.
 - .5 All existing Mechanical equipment shall be removed from the site and recycled in accordance with Provincial and/or Federal regulations governing

- .3 Electrical Removals
 - .1 Refer to drawings for Electrical selective demolition scope.
 - .2 All electrical demolition work shall be done in accordance with the Canadian Electrical Code 23rd. edition, 2015, and all local ordinances and bylaws.
 - .3 This contractor shall obtain and pay for all permits, fees, and taxes associated with the electrical demolition and he shall allow for the same in his tender submission.
 - .4 This contractor shall supply all materials, equipment, and labor necessary for the demolition of the existing electrical systems as outlined in these specifications.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA-O86-14, Engineering Design in Wood.
 - .3 CSA S269.1-16, Falsework and Formwork.
 - .4 CSA 0121-08, Douglas Fir Plywood.
- .2 American Concrete Institute (ACI)
 - .1 ACI 301-10, Specifications for Structural Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings for formwork and falsework for concrete formwork and supports in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangements of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework and formwork drawings.
 - .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
 - .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
 - .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in the Province of Newfoundland and Labrador.
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1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal.
- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use wood and wood product formwork materials to CSA-A23.1/A23.2 and CSA O121.
 - .2 Plywood and wood formwork materials to CSA-O121 or CSA-O86.
 - .3 Use new and undamaged forms only for exposed surfaces. Use formwork liners as required to achieve specified finish tolerances.
 - .2 Falsework materials: to CSA S269.1.
 - .3 Form ties:
 - .1 Use removable or snap-off galvanized metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Holes are to be filled with non-shrink grout.
 - .2 Adjustable in lengths to permit tightening and alignment of forms.
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- .4 Form release agent: non-toxic, biodegradable, low VOC, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.
- .5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm² /sat 40°C, flashpoint minimum 150°C, open cup. Agent shall be compatible with bridge sealing and waterproofing systems where applicable.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines and levels before proceeding with formwork/falsework and ensure dimensions agree with drawings. Review all drawings and check dimensions prior to construction for proper fit and report any discrepancies before proceeding with the work.
 - .2 Obtain Departmental Representative's approval for use of earth forms.
 - .3 Obtain Departmental Representative's approval before framing openings not indicated on drawings.
 - .4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
 - .5 Assemble formwork so that concrete is not damaged during its removal.
 - .6 Provide form finishes as per CAN/CSA A23.1 and ACI 301 as follows:
 - .1 Footings: rough form finish to CSA A23.1.
 - .2 Walls exposed to view plus 500mm below ground surface: Rubbed finish to ACI 301.
 - .3 All other formed concrete surfaces unless otherwise indicated: Rubbed Finish to ACI 301.
 - .4 Repair all deficient areas prior to proceeding with other finishes.
 - .7 Do not place shores and mud sills on frozen ground.
 - .8 Provide site drainage to prevent washout of soil supporting mud sills and shores.
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- .9 Fabricate and erect falsework and formwork in accordance with CSA-S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
 - .10 Align form joints and make watertight. Keep form joints to minimum.
 - .11 Locate horizontal form joints for walls and pilasters below top of finished grade. Minimize vertical form joints for walls above top of finished grade. Align horizontal form joints with recesses, reveals and other features of the structure. Use non-standard size panels and reduced maximum tie spacings required to achieve panel layout.
 - .12 Form slots, openings, drips, recesses, expansion and control joints as indicated.
 - .13 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.
 - .14 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.
 - .15 Clean formwork as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matters. Ensure that water and debris drain to exterior through clean-out ports.
 - .16 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.
 - .17 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
 - .18 Construction Joints:
 - .1 Form construction joints where required and as approved.
 - .2 Build waterstops into forms, supported against displacement by pouring of concrete.
 - .3 Use preformed waterstop corners and intersections where they are available to suit conditions.
 - .4 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.
 - .19 Clean formwork in accordance with CSA A23.1/A23.2 before placing concrete.
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- .20 Apply form release agent to all formed surfaces prior to casting concrete.

3.2 REMOVAL AND RESHORING

- .1 Notify Departmental Representative prior to form removal.
- .2 Form removal times are dependent on proper curing as specified herein.
- .3 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .4 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 3 days for footings and walls.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.
- .6 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
- .7 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A1064/A1064M-13, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - .2 ASTM D 1751-04(2013)E1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
 - .3 CSA International
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .3 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .4 Environmental Choice Program (ECP)
 - .1 CCD-016-97(R2005), Thermal Insulation Materials.
 - .2 CCD-045-95, Sealants and Caulking Compounds.
 - .5 Green Seal Environmental Standards (GS)
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
 - .2 GS-36-00, Commercial Adhesives.
 - .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
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- .7 South Coast Air Quality Management District (SCAQMD),
California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .8 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
- .9 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for insulated concrete forms, ties, joints, ties, and braces and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Before fabrication, submit drawings of insulated concrete form building system.
 - .3 Indicate method and schedule of construction, shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, corner, intersection and connector ties, braces and locations of temporary embedded parts.
 - .4 Indicate sequence of erection of forms as directed by Departmental Representative.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
-

- .5 Test Reports: submit test reports for thermal resistance, water vapour permeance, flexural compressive strength, and rigidity from approved independent testing laboratories, indicating compliance with specified performance characteristics and physical properties.

1.4 QUALIFICATIONS

- .1 Installers, supervisors and inspectors: trained and certified by ICF manufacturer.
- .2 Submit certification letter to Departmental Representative from ICF manufacturer listing ICF installer/supervisor/inspector's name, address, level of certification and certification number.
- .3 Submit inspection schedule to Departmental Representative for each item of work to be inspected prior to placement of concrete and for work to be inspected during and after placement of concrete in accordance with ICF manufacturer's recommendations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground, protected from direct sunlight using light-coloured opaque polyethylene film and ventilated to prevent excessive temperature.
 - .2 Replace defective or damaged materials with new.
 - .4 Develop Construction Waste Management Plan related to Work of this Section.
 - .5 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Insulation: closed cell extruded polystyrene rigid boards to CAN/ULC-S701, RSI 0.87 per 25 mm of thickness, 210 Kpa compressive strength, Ecologo certified CFC free.
 - .2 Web spacer: Manufacturer's standard polypropylene web spacer, flush with panel interior, flared, snap-in reinforcement bar mounting points, mechanical interlock system.
 - .3 Connector Ties: Manufacturer's standard, polypropylene, designed for intended function and to prevent thermal bridging.
 - .1 Supply one-piece corner ties, T-intersection, and hinged connection ties.
 - .4 Inserts: moulded inside panels, reinforcement against bulging, integral slide for web spacers.
 - .5 Bracing: Manufacturer's standard internal alignment brace.
 - .6 Anchor Bolts: to CSA G40.20/G40.21, Grade 300W.
 - .7 Furring Channels: 0.5 mm core thickness galvanized steel channels.
 - .8 Polyurethane Spray Foam: compatible with polystyrene, as and when recommended by ICF manufacturer.
 - .9 Concrete: in accordance with Section 03 30 00 - Cast-in-place Concrete to CSA A23.1, 25 MPa at 28 days, Exposure class F-2, 20 mm maximum size aggregate; 75 mm slump at time of deposit, plus or minus 10 mm; 4 to 7 percent air entrainment.
 - .1 Recycled content: incorporate SCM's in concrete mix, minimum of % post-industrial recycled content.
 - .10 Welded Wire Fabric: in accordance with Section 03 20 00 - Concrete Reinforcing steel, to ASTM, flat sheets, sizes as indicated.
 - .11 Reinforcing Bars: in accordance with Section 03 20 00 - Concrete Reinforcing to CSA G30.18, Grade 400 deformed.
 - .12 Joint Filler: preformed, asphalt saturated fibre to ASTM D 1751.
 - .13 Sealant: multi-component, chemical curing to CAN/CGSB-19.24, Type 1, Class B, with compatible primer for concrete.
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- .1 VOC limit maximum to SCAQMD Rule 1168.
- .14 Adhesive: as recommended by ICF manufacturer.
 - .1 VOC limit maximum to SCAQMD Rule 1168.
- .15 Sealing Tape: as recommended by ICF manufacturer.
- .16 Panel Protective Coating: parging in accordance with manufacturer's written recommendations.
 - .1 VOC limit maximum to SCAQMD Rule 1113.

2.2 COMPONENTS

- .1 Pre-assembled Wall Sections: profiles, comprised of layers of factory processed rigid board insulation connected with web spacers, connectors, inserts, purpose-made ties and bracing.
- .2 Corner Kits: Manufacturer's standard factory-processed 90 degree corner kits.
- .3 Special Shapes: angle corners as indicated on Shop Drawings.

2.3 FABRICATION

- .1 Fabricate panels and special shapes in shop to facilitate on-site assembly with mechanically-interlocked joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for insulated concrete form installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Verify lines, levels and centres before proceeding with form erection.
 - .1 Ensure site dimensions agree Shop Drawings.
 - .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
-

3.2 PREPARATION

- .1 Cover and protect adjacent materials before beginning Work.
- .2 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 INSTALLATION

- .1 Install forms to lines and levels, widths and sizes indicated on Shop Drawings, including special shapes.
 - .2 Place forms on standard footing or concrete pad as indicated and temporarily brace to prevent displacement during final assembly and concrete pour.
 - .3 Keep form joints to minimum.
 - .4 Align form joints and make watertight.
 - .5 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
 - .6 Build in anchors, sleeves and other inserts required or specified in other Sections of Project Manual and as indicated.
 - .1 Ensure anchors and inserts do not protrude beyond surfaces designated to receive applied finishes.
 - .7 Include external bracing as indicated on Shop Drawings.
 - .8 Include vertical braces along one side of form and anchor with dimensional lumber.
 - .9 Include diagonal bracing to align and support forms as indicated on Shop Drawings.
 - .10 Install reinforcing to CSA A23.1 Section 03 20 00 - Concrete Reinforcing.
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- .11 Reinforce service penetrations exceeding 400 x 400 mm in size.
- .12 Apply adhesive and sealing tape to panel intersections in accordance with ICF manufacturer's instructions.
- .13 Apply protective coating to panel forms in accordance with manufacturer's written recommendations.
- .14 Install concrete in accordance with Section 03 30 00 - Cast-in-place Concrete to CSA A23.1.

3.4 FIELD QUALITY CONTROL

- .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
- .2 Submit manufacturer's reports to Consultant within 3 days of manufacturer representative's review.
- .3 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, erecting insulated concrete forms.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Ensure manufacturer's representative is present before and during critical periods of installation construction of field joints and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
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- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove protective coverings from accessories and components.
 - .2 Repair or replace damaged materials.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 When rigid polystyrene insulation boards will remain exposed to sunlight for more than 60 days, protect insulation from ultra-violet radiation by installing temporary covers.
- .3 Repair damage to adjacent materials caused by insulated concrete form installation.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA-G30.3-M1983, Cold Drawn Steel Wire for Concrete Reinforcement.
 - .3 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CSA-A23.3-14, Design of Concrete Structures for Buildings.
 - .5 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.
- .2 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.
- .3 American Concrete Institute (ACI)
 - .1 ACI 315R-93, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit reinforcing steel shop drawings for review by the Departmental Representative. General Contractor to provide stamp indicating items have been reviewed and coordinated.
 - .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, splice lengths locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without references to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .3 Prepare reinforcement drawings in accordance with RSIC Reinforcing Steel Manual of Standard practice.
-

- .4 Detail splice lengths to CSA-A23.3 as follows:
 - .1 All splices to be tension lap splices, class "B".
 - .2 No more than 50% of the reinforcing to be spliced at any given location.
 - .3 Do not splice near locations of maximum stress.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: minimum 1.5 mm diameter to CAN/CSA G30.3.
- .4 Chair, bolsters, bar supports, spacers: to CSA-A23/A23.2, adequate for strength and support of reinforcing during construction conditions, all of which to be non-staining. Do not use metal chairs. Colour to be grey where all or portions of the chair may remain exposed.
- .5 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and RSIC Reinforcing Steel Manual of Standard Practice. Shop fabricate and bend all reinforcing steel.
 - .2 Fabricate to the following tolerances:
 - .1 Sheared length + 25 mm.
 - .2 Stirrups, items and spirals to + 10 mm.
 - .3 Other bends + 25 mm.
-

- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .4 Welding of reinforcing steel must receive prior approval of the Departmental Representative.
- .5 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .6 Have welding performed by workers qualified under CSA W47.1.
- .7 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to beginning reinforcing work. Mill certificates shall be in accordance with CAN/CSA G30.18.
- .2 Inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine work related to this section and report discrepancies to Departmental Representative.
- .2 Commencement of work shall imply acceptance of conditions.

3.2 FIELD BENDING

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

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
- .2 Provide all chairs, braces, lateral support, headers, ties, etc. to secure reinforcing in place during construction.
- .3 Prior to placing concrete, obtain Departmental Representative's approval for reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete placement.
- .5 Under no circumstances will concrete trucks or vehicles be permitted to travel over the reinforcing during concrete placing operations.
- .6 After reinforcing is placed and prior to closing of forms, notify the Departmental Representative for inspection of the Work.
- .7 Reinforcement shall be adequately supported by chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with CSA-A23.1/A23.2.

3.4 STORAGE

- .1 Store reinforcing steel to prevent deterioration, contamination or disfigurement.
- .2 Store reinforcing steel off the ground.

3.5 CLEANING

- .1 Cleaning reinforcing to CSA-A23.1/A23.2. All reinforced bars are to be free of scale rust and contamination at time of placing in forms.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 Cement: hydraulic cement or blended hydraulic cement (GUb - where b denotes blended).
 - .1 Type GU or GUb - General use cement.
 - .2 Reference Standards:
 - .1 ASTM International
 - .1 ASTM C 260-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C 309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 494/C 494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
 - .5 ASTM C 1017/C 1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM D1751-04(R2013), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .7 ASTM D17520-04a(R2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC, Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - .8 ASTM D2240-05(R2010), Standard Test method for Rubber Property - Durometer Hardness.
 - .2 CSA International
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
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- .3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .5 CSA S269.1-16, Falsework and Formwork.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34-M86(1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 32 167 - Construction Progress Schedules - Critical Path Method (CPM), convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel, site supervisor, Departmental Representative speciality contractor - forming concrete producer, testing laboratories attend.
 - .1 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide testing inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
 - .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
 - .4 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
 - .5 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements and Section 01 35 43 - Environmental Procedures.
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1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Testing and Quality Control.
- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
 - .8 Backfilling.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 CONCRETE DESIGN CRITERIA

- .1 Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 CONCRETE PERFORMANCE CRITERIA

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

2.3 CONCRETE MATERIALS

- .1 Cement: to CSA A3001, Type GU.
 - .2 Hydraulic cement: Type GUb to CSA A3001.
 - .3 Water: to CSA A23.1.
 - .4 Aggregates: to CSA A23.1/A23.2. Coarse aggregates to be normal density.
 - .5 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494 or ASTM C1017. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .3 Obtain authorization from Departmental Representative for use of super plasticizing admixture, water reducer, and/or other admixtures as approved by Departmental Representative to achieve designed concrete properties.
 - .6 Concrete shall be normal and shall have a unit weight of 2350 kg/m³.
 - .7 Curing compound: to CSA A23.1/A23.2 white and ASTM C 309.
 - .8 Premoulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D 1751.
 - .2 Sponge rubber: to ASTM D 1752, Type I, flexible firm grade.
 - .3 Self-expanding Standard cork: to ASTM D 1752, Type III.
 - .9 Weep hole tubes: plastic.
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- .10 Dampproof membrane:
 - .1 Polyethylene membrane:
 - .1 Plain: 15 mil thick polyethylene film.
 - .2 membrane adhesive: as recommended by membrane manufacturer:
 - .2 Bitumen impregnated protection board.
 - .3 Cavity drainage board with geotextile filter fabric.
- .11 Dampproofing:
 - .1 Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2.
- .12 Polyethylene film: to CAN/CGSB-51.34.
- .13 Concrete floor sealers: as per Section 03 35 00 - Concrete Finishing.
- .14 Saw cut joint filler: two component, semi-rigid epoxy filler with shore A hardness at 28 days of greater than or equal to 80, per ASTM D2240. Colour by Departmental Representative.
- .15 Joint Sealants: for interior slab on grade control, construction and isolation joints: to ASTM C920, Class 25.
 - .1 Primers and bond breakers: as per manufacturer's requirements and recommendations and to be compatible with sealant.
 - .2 Joint sealant, filler and accessory products shall be from the same manufacturer.
 - .3 Submit sealant colour from manufacturer's available standard colours to Departmental Representative for review.

2.4 CONCRETE MIXES

- .1 Performance Method for specifying concrete: to meet Departmental Representative performance criteria and to CSA A23.1/A23.2.
 - .2 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .1 Provide concrete mix to meet following plastic state requirements:
 - .1 Uniformity: to CSA A23.1
 - .2 Workability: free of loss of mortar, segregation.
 - .3 Set time: 2 hours maximum.
 - .2 Where approved by Departmental Representative, use superplasticizer in concrete to achieve workability. Pay for all admixtures as required to achieve specified properties.
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Table 2.1

Mix Type	Minimum Specified compressive strength at 28	Exposure Classification	Maximum W/C ratio	Nominal maximum size of coarse	Air content	Type F Flyash or Slag Replacement by mass of total cementitious material
Mud slabs, thrust blocks and fill concrete	20 MPa	N	0.65	10 mm	N/A	15% min 25% max
Interior and Exterior Footings, foundation walls, pilasters. Ductbanks Not exposed to deicing salts	25 MPa	F-2	0.55	20 mm	4-7%	15% min 25% max
Exterior sidewalks, stairs, ramps, pads, hardstands, aprons and concrete pavement.	35 MPa	C-1	0.40	20 mm	5-8%	15% min 25% max
Interior Slab on grade.	25 MPa	N	0.55	20 mm	N/A	15% min 25% max
Interior Slab on deck	25 MPa	N	0.5	20 mm	N/A	15% min 25% max

Notes:

1. Read in conjunction with Part 2.4 - Mixes for additional requirements.
2. Slump at point of discharge; to CSA A23.1-14.
3. Portland Cement type; General Use (GU)

- .3 Maximum concrete temperature delivered: 25 degrees Celsius.
- .4 Maximum temperature gradient: 20 degrees Celsius per meter.
- .3 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .4 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
 - .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
 - .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
 - .4 Pumping of concrete will be permitted only after approval of equipment and mix.
 - .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
 - .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
 - .7 Protect previous Work from staining.
 - .8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
 - .9 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
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- .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .2 Submit product information and data sheets of epoxy grout and anchor system to Departmental Representative for review and approval.
- .10 Do not place load upon new concrete until authorized by Departmental Representative. Backfilling of retaining walls is prohibited until authorized by Departmental Representative.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
 - .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through walls except where indicated or approved by Departmental Representative.
 - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
 - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
 - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
 - .3 Anchor bolts: set anchor bolts to templates in coordination with appropriate trade prior to placing concrete.
 - .4 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
 - .5 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
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- .3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: brushed on exposed pad footings. Provide written declaration that compounds used are compatible.
 - .4 Refer to Section 03 10 00 - Concrete forming and formwork accessories for form finish tolerances.
 - .5 Horizontal surface at top of Sidewalk: Broom finish to CSA A23.1.
 - .6 Top surfaces of curbs, barriers, and approach slab: steel trowelled finish to finish classification D per CAN CSA A23.1.
 - .6 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2 and Section 03 35 00 - Concrete Finishing.
 - .2 Cure concrete to CSA A23.1/A23.2.
 - .3 use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible. Moisture cure where finishes are incompatible with curing compound. Wet cure slab-on-grade.
 - .4 Protect concrete from adverse conditions such as premature drying and temperature extremes. Cure at temperature of at least 10°C for minimum three (3) days.
 - .5 Curing Type in accordance with specified exposure classification unless more stringent requirements noted otherwise.
 - .6 Concrete slab-on-grade: Curing Type 2, wet cure for minimum seven (7) days at 10°C or greater for time necessary to obtain 70% of specified concrete strength using:
 - .1 Non-straining absorptive mat or fabric kept continuously wet.
 - .2 Curing mats shall be thoroughly wet when applied and kept continuously wet in full contact with concrete surface for duration of required curing period. Mats shall cover entire concrete surface with lapped joints. Place mats on concrete immediately after disappearance of surface water sheen after final finishing pass.
 - .3 Lap joints minimum 75 mm and seal with waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.
 - .4 Remove curing cover and allow concrete to air dry for at least twelve (12) hours prior to applying liquid densifier/sealer.
 - .7 Apply floor sealer as per manufacturer's recommendations to areas specified in finish schedule. Refer to Section 03 35 00 - Concrete Finishing.
 - .8 prior to application of non-breathable floor finishes/coatings test for moisture content in compliance with ASTM D4263.
 - .7 Saw cut control joints:
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- .1 Saw cut by early entry dry-cut method as early as practicable or alternatively by conventional wet-cut method between 4-12 hours after concrete placement. Ensure that reinforcement and work of other sections are located below cutting line.
 - .2 Use white or light grey chalk for chalk-lining sawcuts. Do not use red, blue or any colour with a dye that may stain floor.
- .8 Joint filers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
 - .2 When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form isolation, construction and expansion joints as indicated.
 - .4 Install joint filler.
 - .5 Use 12 mm thick joint filler to separate slab-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finishes slab surface unless indicated otherwise.
 - .6 Fill interior saw-cut control and construction joints in slab-on-grade with joint filler and joint sealant. Minimum concrete age prior to installation: greater of 120 days or Manufacturers' recommendation for best performance. Clean dust and debris from saw cuts and adjacent area. Place joint filler to within 12 mm of top of slab. Fill top 12 mm of joint with sealant. Shave over-fill flush with slab surface once joint filler or sealant has cured sufficiently. Tape joint sides to prevent slab discolouration and to ease overfill removal.
- .9 Dampproof membrane:
- .1 Install dampproof membrane under concrete slab-on-grade inside building.
 - .2 Lap dampproof membrane minimum 150 mm at joints and seal.
 - .3 Extend membrane up edges to top of slab at junctions with vertical construction elements, foundation walls and pits.
 - .4 Seal punctures in dampproof membrane before placing concrete. use patching material at least 150 mm larger than puncture and seal.
 - .5 Seal membrane to pipe and conduit penetration.

3.3 SURFACE TOLERANCE

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

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Testing and Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 3, 7, 28 and 56 days as required by CSA-A23.1/A23.2.
 - .5 Air and concrete temperature.
 - .6 Weather.
 - .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
 - .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
 - .4 Departmental Representative will pay for costs of tests as specified in Section 01 29 00 - Payment Procedures.
 - .5 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
 - .6 For compressive strength testing, a minimum of 3 cylinders and 2 field cured cylinders are required for:
 - .1 Each day's pour
 - .2 Each type of grade of concrete
 - .3 Each change of supplier
 - .4 Each 40 cubic metre or fraction thereof for footings and foundation walls.
 - .5 Additional test specimens shall be taken whenever requested by the Departmental Representative to verify the concrete quality.
 - .7 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
 - .8 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.
-

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Divert unused concrete materials from landfill to local quarry facility after receipt of written approval from Departmental Representative.
 - .2 Provide appropriate area on job site where concrete trucks and be safely washed.
 - .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
 - .4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .5 Prevent admixtures and additive materials from entering drinking water supplies or streams.
 - .6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.
 - .7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

3.6 CURING

- .1 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.
 - .2 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials applied to concrete surfaces. Use only moisture curing.
 - .3 Protect the concrete from premature drying and extremes of temperature.
 - .4 Cure, protect and finish concrete to CSA A23.1 and CSA S269.1. Curing type in accordance with specified exposure classification unless more stringent requirements are noted otherwise. Special curing and finishing requirements are as follows:
 - .1 Exterior and interior pads and slabs-on-grade: curing "TYPE 2". Seven (7) days total at >10°C and for the time necessary to attain 70% of the specified concrete strength.
-

- .5 Foot traffic shall be kept off curing concrete for 1 day.
- .6 Vehicles shall be kept off concrete for 7 days.

3.7 DEFECTIVE WORK

- .1 Repairs and classification of unacceptable concrete to be in accordance with CSA-A23.1/A23.2.
- .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
- .3 Excessive honeycomb or embedded debris in any concrete shall deem it defective. Remove and replace defective concrete.
- .4 Remove to bare concrete curing compounds detrimental to application of specified finishes.
- .5 Concrete to be supplied at the minimum strength requirement at 28 days. Tests indicating strengths lower than specified will necessitate further testing as required by the Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, the Departmental Representative has the right to require strengthening of the affected area or removal and replacing of the weak concrete all to the Contractor's expense.
- .6 Repair all shrinkage cracks in the completed concrete work employing a suitable epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 Canadian International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005(July 2012), Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Testing and Quality Control.
- .2 Minimum 4 weeks prior to starting concrete finishing work, provide proposed quality control procedures for review by Departmental Representative on following items.
 - .1 Hardening.
 - .2 Sealing.
 - .3 Curing.
 - .4 Finishes.
- .3 Mock-Ups:
 - .1 Provide site mock-up for concrete finishes indicating methods and materials, and procedures proposed to achieve concrete finishes in accordance with Section 01 45 00 - Testing and Quality Control, and to comply with following requirements, using materials indicated for completed work.
 - .1 Build mock-ups in location and of size as directed by Departmental Representative.
 - .2 Obtain Departmental Representative's acceptance of mock-ups to be used throughout construction period and used as standard of acceptance for subsequent architectural concrete work.
 - .3 Mock-up may form part of permanent structure when accepted by Departmental Representative repair or replace unacceptable mock-ups at no additional cost to Owner.
 - .4 In presence of Departmental Representative, damage part of exposed face for each finish, colour, and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary Lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
 - .2 Electrical Power:
 - .1 Provide sufficient electrical power to operate equipment normally used during construction.
 - .3 Work area:
 - .1 Make work area water tight protected against rain and detrimental weather conditions.
 - .4 Temperature:
-

.1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.5 Moisture:

.1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

.6 Safety:

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

.7 Ventilation:

.1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.2 Provide continuous ventilation during and after coating application.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common product Requirements and with manufacturer's written instruction.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

.1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.

.2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives. Components include sealing, curing and hardening compounds.

2.2 SEALING COMPOUNDS

- .1 Liquid densifier/sealer: high performance, deeply penetrating concrete densifier; odourless, colourless, VOC compliant, non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors. The compound must contain a minimum solids content of 20%, of which 50% is silicate. Sealer to be supplied by an ISO 9001-2000 registered manufacturer. Ensure compatibility with floor finishes and hardening compounds as applicable.
- .2 Surface sealer: to CAN/CGSB-25.20, Type 2 - water based, clear colour.
- .3 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1158.

2.3 CURING COMPOUNDS

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

2.4 CONCRETE STAINS

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

2.5 MIXES

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

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on shop drawings.

3.2 PREPARATION

- .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Provide finishes to concrete slab-on-grade as follows:
 - .1 Interior slab-on-grade: Provide steel trowelled finish to CSA A23.1/A23.2 Class "B".
-

- .2 Exterior concrete pads: Provide broom finish to CAN/CSA 23.1/A23.2 Class "B".
- .3 Submit procedure and quality control plan to ensure achievement of specified tolerances to Departmental Representative for review prior to commencing floors.
- .3 Finish interior exposed concrete slabs to a tight consistent steel trowel appearance without burnishing surface.
- .4 Use procedures as reviewed by Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .6 Saw cut crack control joints CSA A23.1/A23.2, between 4-12 hours after placing concrete. Refer to Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Provide non-slip light broom finish to exposed interior steps and landings. Provide non-slip medium broom finish to exposed exterior steps, ramps and landings.

3.3 APPLICATION

- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
- .2 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions to areas as specified in finish schedule.
- .4 Clean overspray. Clean sealant from adjacent surfaces.
- .5 Thoroughly clean floor surface using a mechanical scrubber with white pads to ensure no damage is done to surface.
- .6 Apply "Liquid Densifier/Sealer" at a rate of 4.9 - 7.2 m²/L (200-300ft²/US gal) immediately at a time designated by Departmental Representative. Sealer finish to be consistent and uniform in appearance and to satisfaction of Departmental Representative. Reapply at no cost to Owner, as directed by Departmental Representative.
- .7 Select section of floor for initial application. Scrub liquid densifier/sealer at specified rate into concrete surface with mechanical scrubber, using only white pads. In smaller areas and along slab perimeter, a bristle brush may be used.

- .8 Keep surface wet with densifier/sealer at all times during application process. After product thickens, but not more than thirty (30) minutes after initial application, squeegee surface onto floor area next to be treated.
- .9 Continue until entire floor area has been treated. Vacuum to remove excess liquid. Do not leave any residue on surface. Floor may be flushed with water to assist in removal of excess material.
- .10 At completion, squeegee floor dry. Dry mops may be used to clean up excess water if necessary.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 PROTECTION

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

3.6 TOLERANCES

- .1 Concrete finishing tolerance to CSA A23.1/A23.2 for specified finish classification.
- .2 If a discrepancy in tolerance requirements exists between specification sections, construction documents and/or manufacturer's requirements, the more stringent requirements governs, unless directed otherwise in writing by Departmental Representative.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes: Cast-in and drilled-in anchors for concrete.

1.2 RELATED REQUIREMENTS

- .1 Division 03 - Concrete
- .2 Division 04 - Masonry
- .3 Division 5 - Metals
- .4 Division 22 - Plumbing
- .5 Division 23 - Heating, Ventilating and Air Conditioning
- .6 Division 26 - Electrical

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 General: Submit in accordance with Conditions of the Contract and Section 01 33 00 - Submittal Procedures.
 - .2 Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
 - .3 Samples: Representative length and diameters of each type anchor shown on the drawings.
 - .4 Quality assurance Submittals:
 - .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - .5 Manufacturer's installation instructions.
 - .6 Installer Qualifications & Procedures: Submit installer qualifications as stated in Section 1.03.B. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
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1.4 CLOSEOUT SUBMITTALS

- .1 Submit the following:
 - .1 Record Documents: project record documents for installed materials in accordance with Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications:
 - .1 Drilled in anchors shall be installed by a Contractor Installer with experience performing similar installations.
- .2 Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Contractor Installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
 - .1 Hole drilling procedure.
 - .2 Hole preparation and cleaning technique.
 - .3 Adhesive injection technique and dispenser training/maintenance.
 - .4 Rebar dowel preparation and installation.
 - .5 Proof loading/torquing.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 General: Comply with Section 01 61 00 - Common Product Requirements.
 - .1 Store anchors in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fasteners and Anchors:
 - .1 Bolts and Studs: ASTM A307, ASTM A449 where "high strength" is indicated on the Drawings.
 - .2 Carbon and Alloy Steel Nuts: ASTM A563.
 - .3 Carbon Steel Washers: ASTM F436.
 - .4 Carbon Steel Threaded Rod: ASTM A36, or ASTM A193 Grade B7, or ISO 898 Class 5.8.
 - .5 Wedge Anchors: ASTM A510, or ASTM A108.
-

- .6 Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
- .7 Stainless Steel Nuts: ASTM F594.
- .8 Zinc Plating: ASTM B633.
- .9 Hot Dip Galvanizing: ASTM A153.
- .10 Metric Anchor Bolts, Screws, and Studs: ISO 898 Part 1.
- .11 Metric Anchor Nuts: EN 24033.
- .12 Metric Anchor Stainless Steel Bolts, Screws, and Studs: ISO 3506 Part 1.
- .13 Metric Anchor Stainless Steel Nuts: ISO 3506 Part 2.
- .14 Reinforcing Dowels: ASTM A615.

2.2 CAST-IN-PLACE BOLTS

- .1 Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable. Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.

2.3 DRILLED-IN ANCHORS

- .1 Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings. Type and size as indicated on Drawings.
 - .1 Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
 - .2 Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - .3 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by Departmental Representative, provide the following:
 - .1 Hilti Kwik Bolt 3.
 - .2 Hilti Kwik Bolt TZ (carbon steel and AISI Type 304 Stainless Steel).
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- .2 Screw Anchors: screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.
 - .1 Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8 m min.).
 - .2 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by Departmental Representative, provide the following:
 - .1 Hilti Kwik-HUS-EZ.
 - .2 Hilti Kwik-HUS EZ-1.
 - .3 Hilti Kwik-HUS.
 - .3 Heavy Duty Metric Sleeve Anchors: Torque-controlled, exhibiting follow-up expansion under load, with provision for rotation prevention during installation. Type and size as indicated on Drawings.
 - .1 Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 m min.).
 - .2 Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI Type 304 and Type 316 stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - .3 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by Departmental Representative, provide the following:
 - .1 Hilti HSL, HSLG or HSLB.
 - .2 Hilti HSL-3, HSL-3-G, or HSL-3-B (carbon steel).
 - .4 Heavy Duty Metric Undercut Anchors: Bearing-type. Installed anchor shall have a minimum tension bearing area in the concrete, measured as the horizontal projection of the bearing surface, not less than two times the net tensile area of the anchor bolt. The installed anchor shall exhibit a form fit between the bearing elements and the undercut in the concrete. Type and size as indicated on Drawings.
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.1 Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5 m min.).

.2 Exterior Use: As indicated on the Drawings, provide sherardized or stainless steel anchors. Sherardized anchors shall be manufactured from materials conforming to ISO 898 Part 1 and having corrosion resistance equivalent to ASTM A153 with sherardized dry diffusion zinc coating (50 µm min.). Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI Type 316 stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

.3 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by Departmental Representative, provide the following:

.1 Hilti HDA.

.5 Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.

.1 Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038.

.2 Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified.

Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

.3 Reinforcing dowels shall be A615 Grade 60.

.4 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by Departmental Representative, provide the following:

- .1 Hilti HAS threaded rods with HIT HY 200 Safe Set System using Hilti Hollow Drill Bit System for anchorage to concrete.
 - .2 Hilti HIT-Z anchor rods with HIT-HY 200 Safe Set system for anchorage to concrete.
 - .3 Hilti HAS threaded rods with RE 500 SD Injection Adhesive Anchoring system for anchorage to concrete.
 - .4 Hilti HAS threaded rods with RE 500 Injection Adhesive Anchoring System for anchorage to concrete.
- .6 Capsule Anchors: Threaded steel rod, inserts and reinforcing dowels with 45 degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Drawings.
- .1 Interior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed carbon steel rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
 - .2 Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - .3 Reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.
 - .4 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following:
 - .1 Hilti HVA Adhesive System with HVU capsules.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in formwork.
 - .2 Drilled-In Anchors:
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.1 Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, and/or core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.

.1 Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.

.2 Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

.3 Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

.2 Perform anchor installation in accordance with manufacturer instructions.

.3 Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by Departmental Representative.

.4 Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components.

Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

.5 Capsule Anchors: Perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

.6 Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.2 REPAIR OF DEFECTIVE WORK

- .1 Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.3 FIELD QUALITY CONTROL

- .1 Testing 10% 25% _____ of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any more than 10% _____ of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by Departmental Representative.
 - .1 Tension testing should be performed in accordance with ASTM E488.
 - .2 Torque shall be applied with a calibrated torque wrench.
 - .3 Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed $D/10$, where D is the nominal anchor diameter.
- .2 Minimum anchor embedments, proof loads and torques shall be as shown on the drawings.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Division 03 - Concrete.
- .3 Division 06 - Wood, Plastics and Composites.
- .4 Section 09 91 00 - Painting.

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A108-07, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
 - .3 ASTM A193/A193M-12b, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
 - .4 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI (400 MPa) Tensile Strength.
 - .5 ASTM A325-10e1, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .6 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.
 - .7 ASTM A490M-08, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.
 - .8 ASTM F1554-07, Standard Specification for Anchor Bolts, Steel 36,55, and 105-ksi Yield Strength.
 - .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for Use on Structural Steel.
 - .3 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
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- .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-S16-14, Design of Steel Structures.
- .4 CSA-S136-12, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
- .6 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .7 CSA W55.3-08(R2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .8 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 National Research Council of Canada (NRC)
 - .1 NBC 2015, National Building Code of Canada.
- .5 Master Painters Institute
 - .1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.
 - .2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
 - .1 SSPC - SP 1 (2004), Solvent Cleaning.
 - .2 SSPC - SP 6/NACE No. 3 (2007), Commercial Blast Cleaning.
 - .3 SSPC - SP 7/NACE No. 4 (2007), Brush-Off Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .3 Erection drawings:
 - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.
 - .3 Type of equipment used in erection.
 - .4 Temporary bracings.
 - .4 Fabrication drawings:
-

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of Newfoundland and Labrador, Canada.

.5 Source Quality Control Submittals:

.1 Submit copies of mill test reports 4 weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practice in Province of Newfoundland and Labrador, Canada.

.6 Fabricator Reports:

.1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CSA-S16, NBC and CSA-S136 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

- .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Newfoundland and Labrador, Canada for non standard connections.

2.2 MATERIALS

- .1 Structural steel: to CSA-G40.20/G40.21
 - .1 W Sections: Grade 350W.
 - .2 Hollow Structural Sections: Grade 350W, Class 'C'.
 - .3 Rolled Channels and Angles: Grade 300W.
 - .4 Plates: Grade 300W.
- .2 Anchor rods: to ASTM F1554, Grade 36.
- .3 Bolts, nuts and washers: to ASTM A325M unless noted otherwise.
- .4 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer: to CISC/CPMA 2-75 or CISC/CPMA 1-73a solvent reducible alkyd, grey.
- .6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with CSA-S16 CSA-S136 and in accordance with reviewed shop drawings.
- .2 Install shear studs in accordance with CSA W59.
- .3 Continuously seal members by continuous welds, where indicated. Grind smooth where exposed.
- .4 Provide holes for attachment of other work, as shown on structural drawings and/or architectural drawings including by not limited to: bolt holes, anchor holes, anchor rods, brackets, clip angles, wood nailers and similar attachments.
- .5 Provide base plates, bearing plates and wall anchors for structural work bearing on concrete, unless otherwise noted on drawings.

2.4 SHOP PAINTING

- .1 Clean, prepare and shop prime surfaces of structural steel to CSA-S16 and specified CISC/CPMA paint standard except where members to be encased in concrete.
 - .1 For structural steel to receive primer but no top coat paint: to CISC/CPMA 1-73a.
 - .2 For structural steel to receive primer and top coat paint: to CISC/CPMA 2-75. Top coat as indicated.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to SSPC SP 6/NACE No. 3.
- .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 0.37 mm to 0.050 mm, except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces to receive field installed stud shear connections.
 - .3 Surfaces and edges to be field welded.
 - .4 Faying surfaces of slip-critical connections.
 - .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

PART 3 - EXECUTION

3.1 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 Structural steel work: in accordance with CSA-S16 CSA-S136.
 - .2 Welding: in accordance with CSA W59.
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- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.
- .4 Provide certification that welded joint procedures are qualified by Canadian Welding Bureau.

3.3 MARKING

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

3.4 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CSA-S16, CSA-S136 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Departmental Representative.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
 - .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
 - .3 Submit test reports to Departmental Representative within two (2) weeks of completion of inspection.
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- .4 Departmental Representative Owner will pay costs of tests as specified in Section 01 29 00 - Payment Procedures.
- .5 Testing laboratory will verify soundness of representative shop and field welds using visible and magnetic particle testing procedures, and check representative bolted connections with torque wrench; Testing laboratory will also verify bolt tension and plumbness of erected frames. Departmental Representative to determine location and extent of testing.
- .6 Test shear studs in accordance with CSA W59.

3.6 FIELD PAINTING

- .1 Paint in accordance with Section 09 91 00 - Painting.
 - .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC SP 6/NACE No. 3 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 74 19 - Waste Management and Disposal.
- .2 Section 05 12 23 - Structural Steel For Buildings.
- .3 Section 05 21 00 - Steel Joist Framing.
- .4 Section 07 52 00 - Modified Bituminous Membrane Roofing.
- .5 Section 09 91 00 - Painting.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .3 CSA International
 - .1 CSA C22.2 No.79-1978(R2013), Cellular Metal and Cellular Concrete Floor Raceways and Fittings.
 - .2 CSA S16-09, Design of Steel Structures.
 - .3 CSA S136-07(R2012), North American Specification for the Design of Cold Formed Steel Structural Members.
 - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
 - .5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .6 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding).
 - .4 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI 10M-08, Standard for Steel Roof Deck.
 - .2 CSSBI 12M-08, Standard for Composite Steel Deck.
 - .3 CSSBI B13-06, Design of Steel Deck Diaphragms.
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1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for steel decking and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Submit design calculations if requested by Departmental Representative.
 - .3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
 - .4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.
 - .5 Indicate deck fastener type at each support location, appropriate for base steel thickness.

1.4 DELIVERY, STORAGE AND HANDLING

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

2.1 DESIGN CRITERIA

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

2.2 MATERIALS

- .1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A 653/A 653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather, 0.76 mm minimum base steel thickness.
 - .2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
 - .3 Acoustic insulation: fibrous glass 17.5 kg/m³ density minimum profiled to suit deck flutes.
 - .4 Closures: in accordance with manufacturer's recommendations.
 - .5 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm minimum. Metallic coating same as deck material.
 - .6 Primer: zinc rich, ready mix to CAN/CGSB-1.181.
 - .7 Deck fasteners: in accordance with CSSBI B13.
 - .1 For open web steel joists or cold rolled sections between 3-10 mm thick, use carbon-steel nail with 5 µm zinc (ASTM B663, SC1, Type III) and nominal fastener hardness of 55 HRC with 12 mm steel flat washer and steel dome-style top hat washer. length: 21.0 mm or 24.4 mm in accordance with manufacturers' recommendation.
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.2 For top flange thicker than 6.0 mm, use carbon-steel nail with 5 µm zinc (ASTM B663, SC1, Type III) and nominal fastener hardness of 58 HRC with two 15 mm steel cupped washers. Length: 23.8 mm.

.8 Caulking: to Section 07 92 00 - Joint Sealants.

2.3 TYPES OF DECKING

- .1 Steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, flat side laps.
- .2 Acoustic steel roof deck: 0.76 mm minimum base steel thickness, 38 mm maximum deep profile, non-cellular, perforated on vertical face of flutes, flat side laps.
- .3 Composite steel deck: 0.76 mm minimum base steel thickness, 38 mm deep profile, non-cellular, flat side laps.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel decking installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

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

3.3 ERECTION

- .1 Erect steel deck as indicated and in accordance with CSA S136 CSSBI 10M and CSSBI 12M and in accordance with approved reviewed erection drawings.
- .2 Install decking continuous over minimum three (3) spans except where otherwise approved.
- .3 Lap ends: to 50 mm minimum.
- .4 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.
- .5 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.
- .6 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.
- .7 Place and support reinforcing steel as indicated.

3.4 CLOSURES

- .1 Install closures in accordance with approved details.

3.5 OPENINGS AND AREAS OF CONCENTRATED LOADS

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

3.6 CONNECTIONS

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

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Testing and Quality Control.
- .3 Section 01 74 00 - Cleaning.
- .4 Section 01 74 19 - Waste Management and Disposal.
- .5 Section 06 16 53 - Moisture Resistant Sheathing.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A 653/A 653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A 792/A 792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 CSA Standards Association (CSA International)
 - .1 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Sharped Articles.
 - .2 CAN/CSA S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members.
- .3 Canadian Sheet Steel Building Institute (CSSBI)

1.3 SUBMITTALS

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

.4 Drawings to be stamped and sealed by Structural Engineer licensed to practice in the Province of Newfoundland and Labrador.

- .3 Prior to beginning Work, submit: two certified copies of mill reports covering material properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Protect steel studs during transportation, site storage and installation in accordance with CSSBI.
- .2 Handle and protect galvanized materials from damage to zinc coating.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Steel: to CAN/CSA S136, fabricated from ASTM A 653/A 653M, Grade 230 340 steel.
- .2 Zinc coated steel sheet: quality to ASTM A 653/A 653M, with Z180 Z275 designation coating.
- .3 Screws: pan head low profile head, self-drilling, self-tapping sheet metal screws, corrosion protected with minimum zinc coating thickness of 0.008 mm, length mm
- .4 Anchors: concrete expansion anchors or other suitable drilled type fasteners.
- .5 Bolts, nuts, washers: hot dipped galvanized to ASTM A 123/A 123M, 380 600 g/m² zinc coating.
- .6 Touch up primer: zinc rich, to MPI #18.

2.2 STEEL STUD DESIGNATIONS

- .1 Colour code: to CSSBI Technical Bulletin Vol.7, No. 2.
-

2.3 METAL FRAMING

- .1 Steel studs: to CAN/CSA S136, fabricated from metallic coated steel, depth as indicated.
 - .1 Minimum steel thickness of required meet project wind loads and to limit cladding deflection to maximum.
 - .1 L/360 for masonry.
 - .2 L/180 for all other cladding systems.
- .2 Stud tracks: fabricated from same material and finish as steel studs, depth to suit.
 - .1 Bottom track: single piece.
 - .2 Top track: single piece with slotted screw connections at 25mm intervals within 75mm height flanges.
- .3 Bridging: fabricated from same material and finish as studs, 38 x 12 x 1.09 mm minimum thickness.
- .4 Angle clips: fabricated from same material and finish as studs, 38 x 38 mm x depth of steel stud, 1.37 mm minimum thickness.
- .5 Tension straps and accessories: as recommended by manufacturer.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Erect components to requirements of reviewed shop drawings.
 - .2 Anchor tracks securely to structure at 800 mm on centre maximum, unless lesser spacing prescribed on shop drawings.
 - .3 Erect studs plumb, aligned and securely attached with 2 screws minimum.
 - .4 Seat studs into bottom tracks and single piece top track.
 - .5 Install studs at not more than 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
 - .6 Brace steel studs with horizontal internal bridging at mm maximum.
 - .1 Fasten bridging to steel clips fastened to steel studs with screws or by welding.
-

- .7 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.
- .8 Touch up welds with coat of zinc rich primer.
- .9 Anchor, brace, and erect studs to suit seismic requirements in accordance with OBC, NBC, and all other applicable Codes.

3.2 ERECTION TOLERANCES

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

3.3 CUTOUTS

- .1 Cut-outs to be in accordance with reviewed shop drawings.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-place Concrete: Placement of metal fabrications in concrete.
- .2 Section 05 12 23 - Structural Steel: Structural steel column anchor bolts.
- .3 Section 09 91 10 – Painting: Exterior Paint finish.
- .4 Section 09 91 23 – Interior Painting: Interior Paint finish.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A 606/ A 606M-18, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - .4 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA Group
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-14, Design of Steel Structures.
 - .4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding) [Metric].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plates and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29- Health and Safety Requirements.
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canadian Province of construction.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Stainless steel tubing: to ASTM A 269, Type 302 commercial grade seamless welded with AISI No. 4 finish.
- .5 'Corten' steel plate: to ASTM A606-4, 9mm thickness, welded frame per drawings.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Where possible, fit and shop assemble work, ready for erection.

- .3 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Shop coat primer: MPI- INT 5.1A in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.
- .3 Zinc primer: zinc rich, ready mix to MPI- EXT 5.2C in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

2.4 SHOP PAINTING

- .1 Shop prepare steel surfaces to be primed in accordance with SPCC SP 2.
- .2 Primer: VOC limit [250] g/L maximum to GS-11.
- .3 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .4 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.
- .5 Clean surfaces to be field welded; do not paint.
- .6 Powder Coat: Refer to Specification 09 91 23 – Interior Painting.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION - GENERAL

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Weld field connections.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

3.3 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 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

3.5 SCHEDULE

- .1 Stainless steel guard rails and handrails as indicated on drawings.
- .2 Welded Cor-Ten steel A606-4 at exterior landscape box surround as indicated on drawings.
- .3 Steel support components indicated in millwork drawings; exposed surfaces to be primed and field painted.
- .4 Giftshop pivot door Pull sign as indicated on drawings; laser cut aluminum with shop applied powder coat finish.
- .5 Steel supports and trims for partitions as indicated on drawings; exposed items to be field painted.
- .6 Vertical steel plate trims at Doors as indicated on drawings; exposed surfaces to powder coated.
- .7 Horizontal steel trims at Polycarbonate partitions as indicated on drawings; exposed surfaces to be primed and field painted.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Shop fabricated miscellaneous metal items.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-place Concrete: Placement of metal fabrications in concrete.
- .2 Section 04 04 22 00 – Concrete Masonry Units: Placement of metal fabrications in masonry.
- .3 Section 05 12 00 - Structural Steel: Structural steel column anchor bolts.
- .4 Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- .5 Section 05 73 13 – Glazed Decorative Metal Railings
- .6 Section 09 91 10 – Painting: Exterior Paint finish.
- .7 Section 09 91 23 – Interior Painting: Interior Paint finish.

1.3 REFERENCES

- .1 ASTM A53/A53M-10 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM A153/A153M-09 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .3 ASTM A307-10 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .4 CAN/CGSB 1.40-97 - Anticorrosive Structural Steel Alkyd Primer.
- .5 CSA-G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .6 CSA-W59-03 (R2008) - Welded Steel Construction (Metal Arc Welding).
- .7 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings:
 - .1 Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - .2 Indicate welded connections using standard welding symbols. Indicate net weld lengths.

1.5 QUALITY ASSURANCE

- .1 Welded Steel Construction: CSA-W59.

- .2 Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the place where the Project is located.

Part 2 Products

2.1 MATERIALS - STEEL

- .1 Steel Sections and Plates: CAN/CSA-G40.20/G40.21, Grade 350W.
- .2 Steel pipe: to ASTM A53/A53M.
- .3 Bolts, Nuts, and Washers: ASTM A307.
- .4 Welding Materials: Type required for materials being welded.
- .5 Welding Filler Material: CSA-W48.

2.2 FABRICATION

- .1 Fit and shop assemble items in largest practical sections, for delivery to site.
- .2 Fabricate items with joints tightly fitted and secured.
- .3 Continuously seal joined members by continuous welds.
- .4 Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- .5 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- .6 Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATION TOLERANCES

- .1 Squareness: 1/8 inch maximum difference in diagonal measurements.
- .2 Maximum Offset Between Faces: 1/16 inch.
- .3 Maximum Misalignment of Adjacent Members: 1/16 inch.
- .4 Maximum Bow: 1/8 inch.
- .5 Maximum Deviation From Plane: 1/8 inch.

2.4 FINISHES - STEEL

- .1 Prepare surfaces to be primed in accordance with SPCC SP 2.
- .2 Do not prime surfaces in direct contact with concrete or where field welding is required.
- .3 Shop Prime paint items with one (1) coat, unless noted to be galvanized.
- .4 Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M. Zinc coating thickness minimum 2.0 oz/sq ft.
- .5 Non-structural Items: Galvanized after fabrication to ASTM A123/A123M. Zinc coating thickness 1.25 oz/sq ft.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that field conditions are acceptable and are ready to receive work.
- .3 Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

- .1 Clean and strip primed steel items to bare metal where site welding is required.
- .2 Supply steel items required to be embedded in masonry and cast into concrete with setting templates to appropriate sections.

3.3 INSTALLATION

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.
- .2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .3 Field weld components indicated on Drawings.
- .4 Perform field welding to CSA requirements. Welding to structural steel to be performed by Licensed Welders certified to CSA W47.1.
- .5 Obtain approval prior to site cutting or making adjustments not scheduled.
- .6 After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation From Plumb: $\frac{1}{4}$ inch per story, non-cumulative.
- .3 Maximum Offset From True Alignment: $\frac{1}{4}$ inch.
- .4 Maximum Out-of-Position: $\frac{1}{4}$ inch.

3.5 SCHEDULE

- .1 All stainless- steel handrails are to be supplied and installed by this contractor.
- .2 Welded corten steel **A606-4**
- .3 landscape box
- .4 Skate hooks indicated in millwork drawings to be welded and powder coated black.
- .5 Provide and install all structural components indicated in millwork drawings.
- .6 Provide and install masonry top of wall clips
- .7 Provide and install access ladders.
- .8 Provide and install single piece bent stainless steel backsplash behind mop sink.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Waste Management and Disposal.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 09 91 00 - Painting.

1.2 REFERENCES

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
 - .1 ANSI/NAAMM MBG 531-090, Metal Bar Grating Manual.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 325M-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength.
 - .4 ASTM A786/A786M-15, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - .5 ASTM A787/A787M-15A, Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing.
- .3 Canadian General Standards Board (CGSB)
 - .1 CSA G40.20-04/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.3 SYSTEM DESCRIPTION

- .1 Design metal stair, balustrade and landing construction and connections to NBCC 2015 vertical and horizontal live load requirements.
-

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Territory of , Canada.
 - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

1.5 QUALITY ASSURANCE

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

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Steel sections: to CSA G40.20/G40.21 Grade 300 W.
 - .2 Steel plate: to CSA G40.20/G40.21, Grade 260 W, pattern.
 - .3 Steel pipe: to ASTM A 53/A 53M, standard weight, schedule 40 seamless black.
 - .4 Steel tubing: to CSA G40.20/G40.21, Grade, square rectangular round, mm wall thickness, sizes and dimensions as indicated.
 - .5 Slip-resistant treads: to ASTM A786/A786M, galvanized sheet steel with checker plate surface design, commercial grade.
 - .6 Welding materials: to CSA W59.
 - .7 Bolts: to ASTM A 307.
 - .8 High strength bolts: to ASTM A 325M.
-

2.2 FABRICATION

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

2.3 STEEL PAN STAIRS

- .1 Fabricate stairs with closed open riser steel pan construction.
- .2 Form treads and risers from 3 mm thick steel plate. Secure treads and risers to L 35 x 35 x 5 horizontal and vertical welded to stringers.
- .3 Form stringers from minimum size C310 x 31 channels even if lighter channels will meet Code requirements.
- .4 Form landings from steel deck, reinforced by C channels.
- .5 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
- .6 Extend stringers around mid landings to form steel base.
- .7 Design in accordance with reviewed engineered shop drawings and as indicated.

2.4 STEEL PAN STAIRS

- .1 Fabricate stairs with closed riser and steel pan construction.
 - .2 Form threads and risers from steel plate. Risers to be flat plate, treads to be steel pan. Secure treads and risers welded to stringers.
-

- .3 Form stringers from minimum size C310 x 31 channels even if lighter channels will meet Code Requirements.
- .4 Form landings from steel deck, reinforced by C channels.
- .5 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
- .6 Extend stringers around mid landings to form steel base.
- .7 Design in accordance with reviewed engineered shop drawings and as indicated.

2.5 STEEL MESH GUARDS

- .1 Woven wire mesh with perimeter U-channel framing.
- .2 Design in accordance with reviewed engineered shop drawings and as indicated.

2.6 STEEL CHECKPLATE STAIRS

- .1 Fabricate stairs with closed riser and steel checker plate tread construction.
- .2 Form treads and risers from steel plate. Risers to be flat plate, treads to be checker plate. Secure treads and risers welded to stringers.
- .3 Form stringers from minimum C310 x 31 channels.
- .4 Form landings from steel deck, reinforced by C channels.
- .5 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
- .6 Extend stringers around mid landings to form steel base.
- .7 Design in accordance with reviewed engineered shop drawings and as indicated.

2.7 ELEVATOR PIT ACCESS LADDERS

- .1 Designed accordance with CSA B44-07.
-

- .2 Stringers: steel.
- .3 Steel Rungs: 20 mm diameter, welded to stringers at 300 mm on centre.
- .4 Steel Rungs: slip resistant.
- .5 Brackets: sizes and shapes as required, welded to stringers complete with fixing anchors.
- .6 Design in accordance with reviewed engineered shop drawings.

2.8 ROOF STAIR CROSSOVER BRIDGE

- .1 High grade structural aluminum, incorporating profiled and extruded componentry. Include stairs, platforms, kick plates, hand and kneerails to suit required application.
 - .2 Stair tread: length - 600 mm, width - 250 mm, depth - 400 mm.
 - .3 Angle of slop: 30° to 45°.
 - .4 Platform:
 - .1 Loading: 52 psf.
 - .2 Width and height: manufactured to suit application.
 - .3 Decking: 13/22 mm expanded aluminum mesh.
 - .4 Kick plate: 100 mm (H) extruded channel.
 - .5 Guardrail:
 - .1 Guardrail: 1000 mm above platform.
 - .2 Knee rail: 450 mm below guardrail.
 - .3 Post spacing: max. 2.0 m.
 - .6 Working load limit: Design for 1-2 persons (52 psf).
 - .7 Penetrating support system:
 - .1 Provide tube railing, fittings, roof protection mats and seismic braces to building structure.
 - .1 Tube for rails: galvanized G90 finish to the requirements of ASTM A787, 42 mm, 11 gauge.
 - .2 Fittings shall be fluorocarbon finish or hot dipped galvanized to meet requirements of ASTM A787. Includes elbows, crossovers, wall flanges, tees and couplings.
 - .3 Rubber roof protection mats.
 - .4 Seismic restraints in accordance with engineered shopdrawings with sleeves to accommodate roof waterproofing system.
 - .8 Fasteners: All fasteners shall be 304 or 305 stainless steel.
-

- .9 Nitrile Seals: provide nitrile seals between the mounting clamp to aluminum cross over bridge/stair system.
- .10 Acceptable manufacturers:
 - .1 Bird Stairs
 - .2 Precision Stairs
 - .3 Skyline
- .11 Design in accordance with manufacturer's details and reviewed engineered shop drawings.

2.9 PIPE/TUBING BALUSTRADES

- .1 Construct balusters and handrails from steel pipe steel tubing.
- .2 Cap and weld exposed ends of balusters and handrails.
- .3 Terminate at abutting wall with end flange.
- .4 Design in accordance with reviewed engineered shop drawings.

2.10 BAR BALUSTRADES

- .1 Construct bar balustrades as indicated.
- .2 Design in accordance with reviewed engineered shop drawings.

2.11 SHOP FINISHES

- .1 Construct bar balustrades as indicated.
- .2 Design in accordance with reviewed engineered shop drawings.

2.12 SHOP FINISHES

- .1 For interior installations (where indicated): galvanizing: hot dipped galvanizing with zinc coating 600 g/m².
 - .2 For interior installations: shop coat primer.
-

PART 3 - EXECUTION

3.1 INSTALLATION OF STAIRS

- .1 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .2 Secure to building structure in accordance with reviewed engineered shop drawings.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Do welding work in accordance with CSA W59 unless specified otherwise.
- .5 Fill steel pans with concrete in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.
- .7 Install roof stair cross-over bridges as indicated. Seismically secure stairs to building structure in accordance with engineered shop drawings. Waterproof all seismic and other building connections at roof areas in accordance with Section 07 52 00 - Modified Bituminous membrane Roofing.
- .8 Paint finish all exposed primed metal surfaces in accordance with Section 09 91 00 - Painting.

3.2 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 06 15 00 - Wood Decking.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A 123-15 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A 153/A 153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .3 ASTM A 480/A 480M-15 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .4 ASTM A 653/A 653M-15 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM F 2329/F 2329M-15 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
 - .2 American Wood-Preservers' Association (AWPA)
 - .1 AWPA M2-15, Standard for Inspection of Treated Wood Products.
 - .2 AWPA M4-15, Standard for the Care of Preservative-Treated Wood Products.
 - .3 CSA Group
 - .1 CSA O80 Series-2015, Wood Preservation.
 - .2 CSA O322-15, Procedure for Certification of Pressure-Treated Wood Materials for Use in Preserved Wood Foundations.
 - .4 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113-2013, Architectural Coatings.
 - .5 Underwriters Laboratory of Canada (ULC)
 - .1 CAN/ULC-S102 Surface Burning Characteristics of Building Materials and Assemblies.
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1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals:
 - .1 Submit certificate issued by Canadian Wood Preservation Authority (CWPCA) certifying conformity with Environment Canada Technical Recommendation Document for the Design and Operation of Wood Preservation Facilities.
- .3 Quality assurance submittals:
 - .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 For products treated with preservative and/or fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:
 - .1 Information listed in AWP M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWP M2 applicable to specified treatment.
 - .2 Moisture content after drying following treatment with water-borne preservative and/or fire-retardant.
 - .3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.
 - .3 Recommended metal connector and fastener materials and corrosion protection.
 - .4 Product recommendation for field treatment.

1.4 QUALITY ASSURANCE

- .1 Plant inspection of products treated with preservative and fire-retardant by pressure impregnation will be carried out by designated testing laboratory to AWP M2, and revisions specified in CSA O80 Series, Supplementary Requirements to AWP M2.
 - .2 Each piece of lumber and plywood for preserved wood foundations to be identified by CSA O322 certified stamp.
 - .3 Inspection and testing of insert materials will be carried out by a Testing Laboratory designated by Departmental Representative.
 - .4 Departmental Representative will pay for costs of tests as specified in Section 01 29 00 - Payment Procedures.
 - .5 Regulatory Requirements:
-

- .1 Each board or bundle of fire-retardant treated material panel to bear ULC label indicating Flame Spread Classification (FSC), and smoke developed.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and Section 06 10 00 - Rough Carpentry, with AWP M4 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with product category, manufacturer's name and address.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Store separated reusable treated wood waste convenient to cutting station and work areas.

PART 2 - PRODUCTS

2.1 PRESERVATIVE TREATED WOOD MATERIALS AND APPLICATION

- .1 Provide preservative treated lumber and plywood in accordance with CSA O80 Series standards as specified below.
- .2 Lumber Battens in rainscreen cavities:
 - .1 Use Category: 3.2
 - .2 Clause: 9.7
- .3 Plywood Battens in rainscreen cavities:
 - .1 Use Category: 3.2
 - .2 Clause: 9.7 and 9.2.2.5.
- .4 Sawn Lumber Battens in rainscreen cavities:
 - .1 Use Category: 3.2
 - .2 Clause: 9.7
- .5 Cant strips above ground:
 - .1 Use Category: 3.2
 - .2 Clause: 9.2
- .6 Decking, above ground, exterior:
 - .1 Use Category: 3.2

- .2 Clause: 9.2 and 9.2.2.5
- .7 Deck joists and support posts in ground and/or fresh water contact:
 - .1 Use Category: 4.1
 - .2 Clause: 9.2 and 9.2.2.5
- .8 Furring strips, above ground, exterior, between cladding and weather barrier:
 - .1 Use Category: 3.2
 - .2 Clause: 9.2 and 9.2.2.5
- .9 Building construction, interior, damp:
 - .1 Use Category: 2
 - .2 Clause: 9.
- .10 Permanent wood foundation:
 - .1 Use Category: 4.2
 - .2 Clause: 9.2 and 9.2.2.1.

2.2 FIRE-RETARDANT TREATED MATERIALS AND APPLICATION

- .1 Provide fire retardant treated lumber for interior use conforming to CSA O80 Series standards use category F1 and clause 9.9, to provide the following characteristics when tested in accordance with CAN/ULC-S102:
 - .1 Flame Spread Classification: FSC as per NBCC.
 - .2 Smoke developed of not more than: as per NBCC.
- .2 Provide fire retardant treated interior plywood conforming to CSA O80 Series standards use category F1 and clause 9.9, to provide the following characteristics when tested in accordance with CAN/ULC-S102:
 - .1 Flame Spread Classification: FSC as per NBCC.
 - .2 Smoke developed of not more than: as per NBCC.
- .3 Kiln dry fire retardant treated products after treatment to the following moisture contents:
 - .1 Plywood: 15%.
 - .2 Lumber: 19%.

2.3 CORROSION PROTECTION FOR CONNECTORS AND FASTENERS FOR USE WITH TREATED WOOD

- .1 Connectors: Fabricated from steel sheet galvanized in accordance with ASTM A 653 to minimum G185 coating or galvanized post fabrication to ASTM A 123.

- .2 Fasteners: Hot dip galvanized to ASTM A 153/A 153M Class C and D.

2.4 PRESERVATIVE FOR FIELD TREATMENT

- .1 Type recommended by manufacturer to suit specified pressure treated products.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- .1 Incorporate treated wood products into construction in accordance with Section 06 10 00 and as indicated on drawings.
- .2 Use connectors and fasteners with specified corrosion protection in all construction with treated wood products.
- .3 Provide barrier membrane where indicated.

3.2 FIELD TREATMENT

- .1 Comply with AWP A M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWP A M2.
- .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of recommended preservative before installation.
- .3 Remove chemical deposits from surfaces of treated wood to receive applied finish.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 06 05 73 - Wood Treatment.
- .3 Section 06 15 00 - Wood Decking.
- .4 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
 - .1 ANSI/NPA A208.1-2009, Particleboard.
 - .2 ASTM International
 - .1 ASTM A 123/A 123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .3 ASTM C 578-11a, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .4 ASTM C 1289-11, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .5 ASTM C 1396/C 1396M-11, Standard Specification for Gypsum Board.
 - .6 ASTM D 1761-06, Standard Test Methods for Mechanical Fasteners in Wood.
 - .7 ASTM D 5055-11, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .8 ASTM D 5456-11, Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC-2013, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
 - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
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- .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .5 CSA International
 - .1 CAN/CSA-A123.2-03(R2008), Asphalt Coated Roofing Sheets.
 - .2 CAN/CSA-A247-M86(R1996), Insulating Fiberboard.
 - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .4 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
 - .5 CSA O121-08, Douglas Fir Plywood.
 - .6 CAN/CSA O122-06(R2011), Structural Glued-Laminated Timber.
 - .7 CSA O141-05(R2009), Softwood Lumber.
 - .8 CSA O151-09, Canadian Softwood Plywood.
 - .9 CSA O153-M1980(R2008), Poplar Plywood.
 - .10 CSA O325-07, Construction Sheathing.
 - .11 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
 - .12 CAN/CSA-Z809-08, Sustainable Forest Management.
- .6 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .7 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .8 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .9 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.
- .10 The Truss Plate Institute of Canada
 - .1 Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses 2007.
- .11 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
- .4 Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
 - .2 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .3 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.
 - .4 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.
 - .2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, and laminate adhesives used in building, stating that they contain no urea-formaldehyde.

1.4 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.
- .3 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

- .1 Description:
 - .1 Sustainability Characteristics:
 - .1 Lumber, Finger Jointed Lumber, Glulam, I-Joists, Trusses, SCL, CAN/CSA-Z809 or FSC or SFI certified.
 - .2 Plywood, OSB urea-formaldehyde free, CAN/CSA-Z809 or FSC or SFI certified.
 - .2 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS.
 - .4 Glulam in accordance with Structural Glued-Laminated Timber CAN/CSA-O122.
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- .5 Wood I-joists in accordance with Prefabricated Wood I-Joists ASTM D 5055.
 - .6 Light-frame trusses in accordance with "Truss Design and Procedures for Light Metal Connected Wood Trusses", The Truss Plate Institute of Canada.
 - .7 Structural Composite Lumber (SCL) in accordance with ASTM D 5456.
 - .8 Framing and board lumber: in accordance with NBC.
 - .9 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S2S.
 - .2 Board sizes: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.
 - .4 Post and timbers sizes: "Standard" or better grade.
 - .10 Plywood, OSB and wood based composite panels: to CSA O325.
 - .11 Douglas fir plywood (DFP): to CSA O121, standard construction.
 - .12 Canadian softwood plywood (CSP): to CSA O151, standard construction.
 - .13 Poplar plywood (PP): to CSA O153, standard construction.
 - .14 Interior mat-formed wood particleboard: to ANSI/NPA 208.1.
 - .15 Mat-formed structural panelboards (OSB wafer): to CAN O437.
 - .16 Insulating fiberboard sheathing: to CAN/ULC-S706.
 - .17 Glass fibre board sheathing: non-structural, rigid, faced, fiberglass, insulating exterior sheathing board.
 - .18 Isocyanurate sheathing: to ASTM C 1289, faced.
 - .19 Expanded polystyrene sheathing: to ASTM C 578.
 - .20 Gypsum sheathing: to ASTM C 1396/C 1396M.

2.2 ACCESSORIES

- .1 Exterior wall sheathing paper: to CAN/CGSB-51.32 laminated type coated as indicated.
 - .2 Polyethylene film: to CAN/CGSB-51.34, Type 1 , 0.15 mm thick.
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- .3 Roll roofing: to CAN/CSA A123.2, Type S.
 - .4 Air seal: closed cell polyurethane or polyethylene.
 - .5 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.
 - .6 Subflooring adhesive: to CAN/CGSB-71.26, cartridge loaded.
 - .1 Adhesives: VOC limit 30 g/L maximum to SCAQMD Rule 1168.
 - .7 General purpose adhesive: to CSA O112.9.
 - .1 VOC limit 70 200 g/L maximum to SCAQMD Rule 1168 GS-36.
 - .8 Nails, spikes and staples: to CSA B111.
 - .9 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
 - .10 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
 - .11 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
 - .12 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.
 - .13 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.
 - .14 Fastener Finishes:
 - .1 Galvanizing: to ASTM A 123/A 123M, use galvanized fasteners for exterior work interior highly humid areas pressure-preservative fire-retardant treated lumber.
 - .15 Wood Preservative:
 - .1 Preservative Coating: in accordance with manufacturer's recommendations for surface conditions:
 - .1 Preservative: VOC limit 350 g/L maximum to SCAQMD Rule 1113.
 - .2 Coatings: VOC limit 100 g/L maximum to SCAQMD Rule 1113.
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PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as indicated:
 - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
 - .2 Wood furring on outside surface of exterior masonry and concrete walls.
 - .3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

3.3 MATERIAL USAGE

- .1 Roof sheathing:
 - .1 Plywood, DFP or CSP sheathing grade.
 - .2 Exterior wall sheathing:
 - .1 Plywood, DFP or CSP sheathing grade T&G.
 - .2 Construction sheathing product: end use mark W24.
 - .3 Subflooring:
 - .1 Plywood, DFP or CSP sheathing grade.
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- .4 Underlay:
 - .1 Plywood, DFP or CSP.
- .5 Combined subfloor and underlay:
 - .1 Plywood, DFP or CSP.
- .6 Electrical equipment mounting boards:
 - .1 Plywood, DFP or CSP.

3.4 INSTALLATION

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.
- .4 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .5 Install subflooring and combined subfloor and underlay with panel end-joints located on solid bearing, staggered at least 800 mm.
 - .1 In addition to mechanical fasteners, floor panels secure floor subflooring to floor joists using screws. Place continuous adhesive bead in accordance with manufacturer's instructions, single-bead on each joist and double-bead on joists where panel ends butt.
- .6 Install wall sheathing in accordance with manufacturer's printed instructions.
- .7 Install roof sheathing in accordance with requirements of NBC.
- .8 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .9 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.

- .10 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .11 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .12 Install sleepers as indicated.
- .13 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.
- .14 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .15 Countersink bolts where necessary to provide clearance for other work.
- .16 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 05 12 23 - Structural Steel for Buildings.
- .3 Section 06 05 73 - Wood Treatment.
- .4 Section 06 10 00 - Rough Carpentry.
- .5 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 CSA International
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA O80 Series-08, Wood Preservation.
 - .3 CSA O86 Consolidation-09, Engineering Design in Wood.
 - .4 CAN/CSA-Z809-08, Sustainable Forest Management.
 - .3 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
 - .4 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Commercial Adhesives.
 - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .6 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.
 - .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
 - .8 Sustainable Forestry Initiative (SFI)
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- .1 SFI-2010-2014 Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood decking and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements 01 35 43 - Environmental Procedures.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .4 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
 - .5 Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20 % of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.
 - .5 Low-Emitting Materials:
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- .1 Submit listing of adhesives and sealants and paints and coatings used in building, comply with VOC and chemical component limits or restriction requirements.
- .2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, and laminate adhesives used in building, stating that they contain no urea-formaldehyde.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood decking from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Develop Construction Waste Management Plan related to Work of this Section.
 - .5 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Wood decking: to NLGA standard Grading Rules for Canadian Lumber select grade Douglas Fir, predrilled at 750 mm on centre for lateral spiking, double tongue and groove and "Veed" one side. Kiln dry decking to 15% maximum moisture content.
 - .1 CAN/CSA-Z809 or FSC or SFI certified.
- .2 Decking lengths: 1.8 to 6 m or longer with a minimum of 90% planks exceeding 3 m. Square end trimmed. For single spans shorter than 3 m use decking of same length as span.
- .3 Nails: to CSA B111, hot dipped galvanized finish; sizes to CSA 086. Supply 200 mm spiral spikes for lateral nailing.
- .4 Splines: galvanized metal, as recommended by decking manufacturer.
- .5 Wood preservative: water borne type to CSA 080 for natural finish.
- .6 Preservative: to Section 06 05 73 - Wood Treatment.
- .7 Fire retardant: to Section 06 05 73 - Wood Treatment.
- .8 Adhesive and Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Adhesives and Sealants: VOC limit 30 g/L maximum to SCAQMD Rule 1168.
 - .2 Coatings: VOC limit 350 g/L maximum to SCAQMD Rule 1113

PART 3 - EXECUTION

3.1 EXAMINATION

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

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Do wood deck work to CSA 086 except where specified otherwise.
- .2 Install decking to CSA 086, continuous over two span pattern.
- .3 Supply minimum of 1 bearing support for each plank except extend cantilevers over two supports. Install sloping deck with tongues up. Join butt ends with splines to assure tight square fit.
- .4 Stagger end joints in adjacent planks minimum of 0.5 m.
 - .1 Separate joints in same area by at least 2 intervening courses.
 - .2 Avoid joints in first fifth of end spans.
 - .3 Minimize joints in middle third of span.
- .5 Apply preservative to end cuts of pressure treated lumber.

3.3 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Testing moisture content of delivered material will be performed by testing laboratory designated by Departmental Representative.
 - .2 Departmental Representative will pay for costs of testing in accordance with Section 01 29 00 - Payment Procedures.
 - .3 Testing moisture content of delivered material will be by testing laboratory designated by Departmental Representative by moisture meter with adjustments for species and temperature.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
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- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

Part 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 Architectural Woodwork Quality Standards, 2nd edition, 2014.
- .2 ASTM International
 - .1 [ASTM A 153/A 153M-\[16\]](#), Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 [ASTM E 1333-\[14\]](#) Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
 - .3 [ASTM F 1667-\[13\]](#) Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian General Standards Board (CGSB)
 - .1 [CAN/CGSB-11.3-\[M87\]](#), Hardboard.
- .4 CSA Group (CSA)
 - .1 [CSA O121-\[08\(R2013\)\]](#), Douglas Fir Plywood.
 - .2 [CSA O151-\[09\(R2014\)\]](#), Canadian Softwood Plywood.
 - .3 [CSA O153-\[M13\]](#), Poplar Plywood.
 - .4 [CAN/CSA-Z809-\[08\(R2013\)\]](#), Sustainable Forest Management.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .6 Underwriters Laboratories of Canada (ULC)
 - .1 [CAN/ULC-S104-\[10\]](#), Standard Method for Fire Tests of Door Assemblies.
 - .2 [CAN/ULC-S105-\[09\]](#), Standard Specification for Fire Door Frames.

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, data sheets and catalogue pages for specified products. Include product characteristics, performance criteria, dimensions and profiles, finish and limitations on use.
 - .2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29.06- Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Prepare and submit shop drawings in general accordance with AWMAC AWS manual.

- .2 Indicate profiles and dimensions, assembly techniques, jointing, methods of fastening, terminations and other related details.
- .3 Indicate materials, thicknesses, finishes and hardware.
- .4 Include schedule or key plan.
- .5 Show profiles, elevations and details at scales recommended by AWMAC AWS.
- .6 Where necessary, show location and type of blocking and backing required within supporting assemblies.
- .4 Samples:
 - .1 Submit triplicate 300 mm long representative samples of each typical item of finish carpentry.
 - .1 Standing and running trim: 300 mm long.
 - .2 Panel materials: 300 mm x 300 mm.
 - .2 Shop applied coating samples:
 - .1 For transparent finish, submit samples of each species and cut of wood veneer to be used, finished as specified.
 - .2 For opaque finish, submit samples for each colour selection, finished as specified.
 - .3 Decorative overlaid composite panels, complete with applied edge treatment and corner treatment, minimum 300 mm x 300 mm.
 - .4 Samples for site applied finish:
 - .1 Furnish four samples of each finish carpentry item and composite panel material to Contractor for preparation of field applied finish samples.
- .5 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics, physical properties and requirements of referenced standards.
- .6 Test and Evaluation Reports: submit certified test reports for composite wood from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 QUALITY ASSURANCE

- .1 Independent inspection/testing agency will be engaged by Departmental Representative for purpose of inspecting and/or testing Work of this Section.
 - .1 Cost of inspection and testing services will be borne by Departmental Representative.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 When accepted, mock-up will demonstrate minimum standard for Work.
 - .3 Do not proceed with work prior to receipt of written acceptance of mock-up by Departmental Representative.
 - .4 Accepted mock-up may remain as part of finished work.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with AWS recommendations and as follows.
- .2 Deliver finish carpentry materials only when area of work is enclosed, plaster and concrete work is dry, area is broom clean and site environmental conditions are acceptable for installation.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Maintain indoor temperature and humidity within range recommended by AWS for location of the Work.
 - .3 Store products on site as specified for minimum 72 hours prior to installation.
 - .4 Store and protect finish carpentry products from moisture, nicks, scratches, and blemishes.
 - .5 Replace defective or damaged materials with new.
- .4 Waste Management: for packaging and materials, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 REGULATORY REQUIREMENTS

- .1 Provide fire labelled frames for openings requiring fire protection ratings. Test CAN4-S104, or [NFPA 252](#) and listed by nationally recognized agency having factory inspection services.

2.2 SUSTAINABILITY CHARACTERISTICS

- .1 Solid lumber and composite wood products: in accordance with [CAN/CSA-Z809](#) or FSC or SFI.

2.3 QUALITY GRADE

- .1 Provide all materials and perform all work of this Section in accordance with AWMAC AWS Custom Grade, except as follows:
 - .1 Economy Grade: mechanical rooms and utility areas storage areas janitor's closets.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.

2.4 MATERIALS

- .1 Softwood and hardwood lumber: Sound lumber to specified AWS grade requirements, kiln-dried to moisture content recommended for location of the Work.
 - .1 Machine stress-rated lumber is acceptable for all purposes.
- .2 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, industrial grade M-2 or M-3, medium density (640-800 kg/m³), thickness 19 mm unless indicated otherwise.

- .1 Use moisture resistant grade 2-M-2 or 2-M-3 for countertops and splash-backs to receive plumbing fixtures.
- .3 Douglas fir plywood (DFP): to [\[CSA O121\]](#), standard construction.
- .4 Canadian softwood plywood (CSP): to [\[CSA O151\]](#) , standard construction.
- .5 Hardwood plywood: to [ANSI/HPVA HP-1].
- .6 Poplar plywood (PP): to [\[CSA O153\]](#), standard construction.
- .7 Hardboard: to [\[CAN/CGSB-11.3\]](#).
- .8 Decorative overlaid composite panels.
 - .1 Decorative overlay, heat and pressure laminated with suitable resin to 12.7 mm thick urea-formaldehyde free core.
 - .2 Overlay bonded to both faces where exposed two sides, and when panel material require surface on one side only, reverse side to be overlaid with a plain (buff) balancing sheet.

2.5 MANUFACTURED SHELVING

- .1 Hardwood plywood:
 - .1 Thickness: 18 mm.
 - .2 Number of plies: 13.
 - .3 Veneer: Baltic Birch species, B/BB grade, flatcut, matching requirement.
 - .4 Sanding: regular sanding.

2.6 FASTENINGS

- .1 Provide screws, bolts, expansion shields and other fastening devices required for satisfactory installation.
- .2 Nails and staples: to [ASTM F 1677](#), stainless steel for exterior work, interior humid areas; plain finish elsewhere.
- .3 Wood screws: to ANSI/ASME 18.6.1, countersunk flush type unless indicated otherwise, in sizes to suit application, galvanized to [ASTM A 153/A 153M](#) for exterior work, interior humid areas, stainless steel for other locations.
- .4 Splines: wood.

2.7 HARDWARE

- .1 Use one manufacturer's product for all similar items.
- .2 Shelf Hardware: to ANSI/BHMA A15 as listed below finished to satin nickel chrome:
 - .1 Shelf brackets.
 - .2 Garment rod and shelf brackets.
 - .3 Garment hooks.

- .3 Hardware fastenings:
 - .1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation of hardware.
 - .2 Exposed fastening devices to match finish of hardware.
 - .3 Use fasteners compatible with material through which they pass.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood products installation in accordance with AWS tolerances and requirements of Contract Documents.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Back prime woodwork before installation, to AWS.

3.3 INSTALLATION

- .1 Install items of finish carpentry in accordance with AWMAC AWS grade specified for respective items.
- .2 In case of conflict between Contract Documents and AWS grade requirements, Contract Documents govern.
- .3 Install items of finish carpentry at locations shown on drawings.
 - .1 Position accurately, level, plumb straight.
 - .2 Fasten and anchor securely.
- .4 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.
- .5 Form joints to conceal shrinkage.

3.4 CONSTRUCTION

- .1 Fastening:
 - .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

- .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
 - .3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.
 - .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .2 Panelling:
- .1 Secure panelling and perimeter trim using adhesive recommended for purpose by manufacturer. Fill nail holes caused by temporary fixing with filler matching wood in colour.
 - .2 Secure panelling and perimeter trim using concealed fasteners.
 - .3 Secure panelling and perimeter trim using counter sunk screws plugged with matching wood plugs.
- .3 Shelving:
- .1 Install shelving on shelf brackets.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 Architectural Woodwork Standards (AWMAC AWS), 2014.
- .2 ASTM International
 - .1 [ASTM A 153/A 153M-\[16\]](#), Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 [ASTM E 1333-\[14\]](#), Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
 - .3 [ASTM F 1667-\[13\]](#) Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian General Standards Board (CGSB)
 - .1 [CAN/CGSB-11.3-\[M87\]](#), Hardboard.
 - .2 [CAN/CGSB-71.20-\[M88\]](#), Adhesive, Contact, Brushable.
 - .3 [CAN/CGSB-71.19-\[M88\]](#), Adhesive, Contact, Sprayable.
- .4 CSA Group (CSA)
 - .1 CSA O112-M Series [1977 (R2006)] Standards for Wood Adhesives.
 - .2 [CSA O121-\[08\(R2013\)\]](#), Douglas Fir Plywood.
 - .3 [CSA O141-\[05 \(R2014\)\]](#), Softwood Lumber.
 - .4 [CSA O151-\[14\]](#), Canadian Softwood Plywood.
 - .5 [CSA O153-\[M1980 \(R2014\)\]](#), Poplar Plywood.
 - .6 [CAN/CSA-Z809-\[08\(R2013\)\]](#), Sustainable Forest Management.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

1.2 PRE-INSTALLATION MEETING

- .1 Prior to enclosing framing, convene a meeting of contractor, casework fabricator, casework installer, framing subcontractor and Departmental Representative.
 - .1 Review locations of backing required for casework installation as shown on shop drawings and as necessary for installation.
 - .2 Review method of attachment for backing to wall system.
 - .3 Review coordination with other affected sections.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Prepare and submit material list in accordance with AWMAC AWS, cross-referenced to specifications.
 - .2 Include manufacturer's instructions, printed product literature, data sheets and catalogue pages for all materials and products to be incorporated into architectural wood casework and include product characteristics, performance criteria, dimensions and profiles, finish and limitations on use.
 - .3 Submit two copies of WHMIS SDS in accordance with Section 01 35 2- Health and Safety Requirements.
- .3 Hardware List:
 - .1 Submit hardware list cross-referenced to specifications.
 - .2 Include manufacturer's specification sheets indicating name, model, material, function, finish, BHMA designations and other pertinent information.
- .4 Shop Drawings:
 - .1 Prepare and submit shop drawings in accordance with AWMAC AWS and as follows.
 - .2 Submit [two] sets of shop drawings for initial review in accordance with requirements of Division 01. Revise as directed, submit [six] copies for final acceptance and distribution.
 - .3 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .4 Indicate materials, thicknesses, finishes and hardware.
 - .5 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
 - .6 Show location on casework elevations of backing required in supporting structure for attachment of casework.
 - .7 Indicate AWMAC AWS quality grade where different from predominant grade specified.
 - .8 Include color schedule of all casework items, including all countertop, exposed, and semi-exposed cabinet finishes, finish material manufacturer, pattern, and color.
- .5 Samples:
 - .1 Prepare and submit samples in accordance with AWMAC AWS and as follows.
 - .2 Apply sample finishes to specified substrate or core material minimum 300 x 300 mm [to match [designer] sample]. For veneers with transparent finish submit three samples to illustrate range and colour of grain expected.
 - .3 Submit duplicate samples of laminated plastic for each specified colour selection.
 - .4 Submit duplicate samples of laminated plastic joints, edging, cutouts and post-formed profiles.

1.4 QUALITY ASSURANCE

- .1 Independent inspection/testing agency may be engaged by Departmental Representative for purpose of inspecting and/or testing Work of this Section.

- .1 Cost of inspection and testing services will be borne by Departmental Representative.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver wood casework only when area of work is enclosed, plaster and concrete work is dry, and area is broom clean and site environmental conditions are acceptable for installation.
- .3 Protect millwork against dampness and damage during and after delivery.
- .4 Store millwork in ventilated areas, protected from extreme changes of temperature and humidity, and within range recommended by AWMAC AWS for location of project.
- .5 Store materials indoors in clean, dry, well-ventilated area.
- .6 Protect architectural woodwork and hardware from nicks, scratches, and blemishes.
- .7 Replace defective or damaged materials with new.
- .8 Waste Management: for packaging and materials, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 QUALITY GRADE

- .1 Provide all materials and perform all fabrication in accordance with AWMAC AWS Custom Grade and as follows, except where specified otherwise:
- .1 Economy Grade: mechanical rooms and utility areas.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.

2.2 LUMBER

- .1 Softwood and Hardwood Lumber: Sound lumber to specified AWMAC AWS quality grade requirements, kiln-dried to moisture content recommended by AWMAC AWS for location of the Work.
- .2 Machine stress-rated lumber is acceptable for all purposes.
- .3 Face framing, pulls, trims, molding, edge-banding, stiles and rails: maple species, in profiles indicated.

2.3 PANEL MATERIALS

- .1 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, industrial grade M-2 or M-3, medium density (640-800 kg/m³), thickness 19 mm unless indicated otherwise.

- .1 Use moisture resistant grade 2-M-2 or 2-M-3 for countertops and splash-backs to receive plumbing fixtures.
- .2 Douglas fir plywood (DFP): to [CSA O121](#), standard construction.
- .3 Hardwood plywood: to CHPA grading rules.
- .4 Canadian softwood plywood (CSP): to [CSA O151](#), standard construction.
- .5 Poplar plywood (PP): to [CSA O153](#), standard construction.
- .6 Hardboard: To [CAN/CGSB-11.3](#).

2.4 DECORATIVE VENEER FACED PLYWOOD

- .1 Decorative hardwood plywood: to specified AWMAC AWS requirements for grade specified for exposed and semi-exposed surfaces:
 - .1 Veneer species: refer to drawings.
 - .2 Thickness: refer to drawings.

2.5 CASEWORK FABRICATION - GENERAL

- .1 Fabricate casework of specified core and surface finish materials to specified AWMAC AWS quality grade.
- .2 Set nails and countersink screws apply stained wood filler to indentations, sand smooth and leave ready to receive finish.
- .3 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.
- .4 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .7 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

2.6 WOOD CASEWORK FABRICATION

- .1 Fabricate casework bodies [of specified veneered plywood panel materials] [of specified veneers laid up as specified] in accordance with AWMAC AWS requirements for grade specified.
- .2 Fabricate door, drawer and panel surfaces of specified veneered plywood panel materials of specified veneers laid up as specified.
- .3 Drawer construction:

- .1 Sides:
 - .1 AWMAC AWS Custom grade: solid wood of manufacturer's species option.
- .2 Bottoms: Hardwood plywood of same species as drawer sides, 6mm thick.
- .3 Joinery: Meeting requirements of AWMAC AWS for Grade specified.

2.7 CABINET HARDWARE

- .1 Cabinet hardware: to AWMAC AWS quality grade specified and to ANSI/BHMA A156.9, designated by letter B and numeral identifiers as listed below.
- .2 Finish:
 - .1 Exposed hardware: satin nickel chrome.
 - .2 Semi-exposed hardware: Manufacturer's standard finish.
- .3 Casework door hinges: concealed European style Grade II hinges minimum 170° opening type,
- .4 Pulls: flush pull, type, , with back plate, type B02191, finished to satin nickel chrome.
- .5 Drawer slides:
 - .1 Slide type: bottom edge mounted drawer slides, type.
 - .2 Extension and capacity: full extension meeting requirements of AWMAC AWS for type and size of drawer.
 - .3 File drawer slides: full extension.

2.8 CABINET LOCKS

- .1 Provide locks as shown on elevations.
- .2 Cabinet locks: to ANSI/BHMA A156.11, designated by letter E.
- .3 Keying: Each room keyed alike.
- .4 Finished to stainless steel.

2.9 ACCESSORIES

- .1 Wood screws: steel, type and size to suit application.
- .2 Nails and staples: to [CSA B111](#) and [ASTM F 1667](#).
- .3 Splines: wood.
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install architectural wood casework in accordance with AWMAC AWS grade for respective items.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.
- .3 Install prefinished millwork at locations shown on drawings.
 - .1 Position accurately, level, plumb straight.
- .4 Fasten and anchor millwork securely.
 - .1 Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .5 Countersink mechanical fasteners at exposed and semi-exposed surfaces, excluding installation attachment screws and screws securing cabinets end to end.
- .6 Use draw bolts in countertop joints.
- .7 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI 208.1-09, Particleboard.
 - .2 ANSI A208.2-09, Medium Density Fiberboard (MDF) for Interior Applications.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 Architectural Woodwork Standards (AWS), 2nd edition, 2014.
- .3 ASTM International
 - .1 [ASTM E 1333-\[14\]](#), Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
- .4 Canadian General Standards Board (CGSB)
 - .1 [CAN/CGSB-71.19-\[M88\]](#), Adhesive, Contact, Sprayable.
 - .2 [CAN/CGSB-71.20-\[M88\]](#), Adhesive, Contact, Brushable.
- .5 CSA Group (CSA)
 - .1 CSA O112-M Series 1977 [(R2006)] Standards for Wood Adhesives.
 - .2 [CSA O121-\[08\]](#), Douglas Fir Plywood.
 - .3 [CSA O151-\[09\]](#), Canadian Softwood Plywood.
 - .4 [CSA O153-\[M1980\(R2008\)\]](#), Poplar Plywood.
 - .5 [CAN/CSA-Z809-\[08\]](#), Sustainable Forest Management.
- .6 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .7 Green Seal Environmental Standards (GS)
 - .1 GS-36-13, Commercial Adhesives.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .9 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High Pressure Decorative Laminates (HPDL).

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 [laminate, adhesive, and core materials] and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit [two] copies of WHMIS SDS in accordance with Section 01 35 29 - Health and Safety Requirements. Indicate VOC's for adhesives in g/L.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit duplicate samples of joints, edging, cut-outs and post-formed profiles.
- .4 Shop Drawings
 - .1 Prepare and submit shop drawings in accordance with AWMAC AWS and as follows.
 - .2 Indicate AWMAC AWS quality grade where different from predominant grade specified.
 - .3 Include color schedule of all plastic laminate work, including all countertop, exposed, and semi-exposed cabinet finishes, finish material manufacturer, pattern, and color.
- .5 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for laminate work for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Perform Work of this Section by plastic laminate fabricator with current experience.
- .2 Independent inspection/testing agency may be engaged by Departmental Representative for purpose of inspecting and/or testing Work of this Section.
 - .1 Costs of inspection and testing services will be paid in accordance with Section 01 21 00 Allowances.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Maintain indoor temperature and humidity within range recommended by the AWMAC Quality Standards for location of the project.

- .3 Store and protect laminate, adhesive, and core materials from nicks, scratches, and blemishes.
- .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: sort for reuse, return, recycling or disposal as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 QUALITY GRADE

- .1 Provide all materials and perform all fabrication in accordance with AWMAC AWS Custom Grade except where specified otherwise, excepting the following:
 - .1 Economy Grade: mechanical rooms and utility areas storage areas janitor's closets.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.

2.2 LAMINATED PLASTIC MATERIALS

- .1 General Purpose Laminate to NEMA LD3.
 - .1 Type: general purpose.
 - .2 Grade: HGS.
 - .3 Thickness: 1.0 mm thick.
 - .4 Colour: integral colour throughout,.
 - .5 Pattern: solid.
 - .6 Finish: satin.
- .2 Laminated plastic for postforming work: to NEMA LD3.
 - .1 Type: postforming.
 - .2 Grade: HGP.
 - .3 Thickness: 1.0 mm thick.
 - .4 Colour: multilayered.
 - .5 Pattern: printed pattern.
 - .6 Finish: satin.
- .3 [High wear type laminate](#) to NEMA LD3.
 - .1 Type: high wear.
 - .2 Grade: HGH.
 - .3 Size: 1.2 mm thick.
 - .4 Colour: multilayered.
 - .5 Pattern: printed pattern.
 - .6 Finish: satin.

- .4 Backer Laminate to NEMA LD3.
 - .1 Type: backer.
 - .2 Grade: BKM.
 - .3 Thickness: same thickness as face laminate.
- .5 Cabinet Liner to NEMA LD3.
 - .1 Type: cabinet liner.
 - .2 Grade: CLS.
 - .3 Thickness: 0.5 mm thick
 - .4 Colour: white.

2.3 ADHESIVES, SEALERS AND ACCESSORIES

- .1 Sealer: water resistant sealer or glue acceptable to laminate manufacturer.
- .2 Sealants: 07 92 00.
- .3 Draw bolts and splines: as recommended by fabricator.
- .4 Edge finishing:
 - .1 Refer to drawing details

2.4 FABRICATION

- .1 Fabricate plastic laminate finished items in NEMA LD3, Annex A and specified AWMAC AWS quality grade requirements.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3000 mm. Keep joints 600 mm from sink cut-outs.
- .5 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.
- .6 Apply laminate backing sheet to reverse side of core of plastic laminate work.
- .7 Apply laminated plastic liner sheet to interior of cabinetry.
- .8 Edge treatment:
 - .1 For HPDL edge treatment use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

- .2 Apply melamine and polyester overlay edge strip in accordance with manufacturer's instructions.
- .3 Apply plastic edge mouldings in accordance with manufacturer's instructions.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for laminate, adhesive, and core materials installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 Install laminated plastic work in accordance with AWMAC AWS Custom Grade, except as follows:
 - .1 Economy Grade: service rooms and utility areas storage areas janitor's closets.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.
- .3 Install work plumb, true and square, neatly scribed to adjoining surfaces.
- .4 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .5 Use draw bolts and splines in counter top joints. Maximum spacing 450 mm on centre, 75 mm from edge. Make flush hairline joints.
- .6 Provide cut-outs for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .7 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section includes labor, materials and other services necessary to provide polycarbonate wall panels.

1.2 RELATED SECTIONS

- .1 Section 06 11 00 - Wood Framing: Framing for wall partitions and openings.
- .2 Section 07 92 00 - Joint Sealants: Perimeter sealant to adjacent construction.

1.3 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on specified component products.
- .3 Shop Drawings: Indicate material dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colours, finishes, methods of support, integration of plumbing electrical components, and anchorages.
- .4 Samples: Submit two (2) samples, 150 x 300 mm (6 x 12inch) in size illustrating colour, texture, and finish.

1.4 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Section 01 78 00: Submission procedures.
- .2 Maintenance Data: Include instructions for regular cleaning and stain removal.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for a flame rating of 25and smoke developed rating of 50in accordance with CAN/ULC-S102 requirements.

1.8 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Construct mockup approximately 3000 mm x 2000 long wide up including trim and accessories.
- .3 Locate where directed by Department Representative.
- .4 Mock-up may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .3 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .4 Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
- .5 Store panels in temperature controlled environments. Leave protective film on panel until ready to use.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 43: Environmental conditions affecting products on site.
- .2 Maintain air temperature and structural base temperature at installation area between 18 C and 26 C for 48 hours before, during and 24 hours after installation.

Part 2 Products

2.1 MANUFACTURERS

- .1 Amerilux; Product: Opal Lexan Thermoclear sheet size per drawings.
- .2 Plasteck; Product: Polygal sheet size per drawings.
- .3 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Palram; Product: Sunlite Multi-wall Polycarbonate sheet sheet size per drawings.
- .4 Substitutions: Refer to Section 01 62 00.

2.2 MATERIALS

- .1 Polycarbonate Sheet Material:
 - .1 Thickness: minimum 32 mm.
 - .2 Colour: Standard Range.

2.3 ACCESSORIES

- .1 Fasteners: stainless steel
- .2 Trim: Aluminum panel connectors and edge trim, profiles as notes on drawings.

2.4 SOURCE QUALITY

- .1 Obtain wall products from a single manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.

- .2 Verify that substrates are ready to receive work and dimensions are as indicated on Shop Drawings.

3.2 SUBSTRATE PREPARATION

- .1 Walls should be smooth and level. High points must be removed and low points filled with filler intended for the substrate and environmental conditions.
- .2 Wall tiles must be fixed firmly to the wall. As long as the tile edges do not protrude you do not have to skim grout joints.
- .3 Surfaces must be permanently dry and free from all substances that may contribute to adhesive bond failure.
- .4 Remove loose paint and conduct an adhesive bond test with paint.
- .5 Exterior walls must be adequately damp-proofed and insulated.
- .6 Dry wall substrates should be paint ready.

3.3 PREPARATION

- .1 All surfaces must be free from dust and cleaned prior to Product installation. The working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate, and may cause the panels to de-bond.
- .2 Very absorbent /porous substrates (plaster finishes, unprimed sheetrock, and CMU) must have a proprietary sealer e.g. PVA primer or similar, applied to the surface a minimum of 12 hours prior to the installation.
- .3 All electrical switches, power points etc., should be in a first fix / installation state. All electrical equipment should only be moved or altered by a qualified electrician.
- .4 All plumbing should have pipe-work removed to a first fix / installation state and "tails" left protruding from the substrate. Wall panels are to be drilled and slid over the pipe tails. All holes should be drilled 1/8" (3mm) oversize to allow for expansion, then sealed with Sanitary Sealant. Plumbing should always be done by a qualified plumber.
- .5 Hot pipes and steam pipes should be insulated and a 3 to 6mm (1/8" to 1/4 inch) expansion gap should be created when installing panels around these pipes, then sealed with Sanitary Sealant.
- .6 All pipes, fixing bolts, etc. extending through the wall panels should have a minimum 1/8" (3mm) expansion gap and be sealed using Sanitary Sealant.
- .7 If fitting to door frames, these must be in place prior to installation of wall panels.
- .8 Prior to installation, it is advisable to complete any painting which comes in contact with wall panels, as sealant used at junctions is non-paintable.
- .9 Panels should be stored flat and be pre-conditioned a minimum of 24 hours in ambient temperatures similar to the prevailing operational conditions.
- .10 The panels must be stored on a level flat surface off the ground (risk of condensation on the panels if stored on damp surfaces). Storage on uneven surfaces could cause the panels to distort prior to installation.

- .11 First, check the room using a 2 m (6 foot) level to ensure all walls are flat; pay particular attention to the corners, window reveals, and door entrances. Substrates need to be free of any debris or irregularities, which could prevent the panels laying flat to the substrate after the adhesive has been applied and the panel installed.

3.4 INSTALLATION

- .1 Install wall panels and accessories to manufacturer's written instructions.

3.5 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum variation from true position: 6 mm (1/4 inch).
- .3 Maximum offset from true alignment: 3 mm (1/8 inch).

3.6 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Clean wall products in accordance with manufacture's written instructions.
- .3 Cleaning the panels with an anti-static solution as recommended by manufacture.
- .4 Clean components of foreign material without damaging finished surface.

3.7 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Place protective covering over installed panels wherever protection is needed.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Batt insulation and vapour retarder in exterior wall and wall construction.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 - Board Insulation.
- .2 Section 07 27 13 – Air Barriers: Air barrier materials to adjacent insulation.
- .3 Section 07 84 00 - Firestopping.

1.3 REFERENCES

- .1 ASTM C665-06 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .2 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 CAN/ULC-S702-09 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .5 UL 723-2008 - Tests for Surface Burning Characteristics of Building Materials (10th Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 19: Project Meetings.
- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance criteria, and limitations.

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.7 CLOSEOUT SUBMITTALS

- .1 Section 01 78 00: Submission procedures.

Part 2 Products

2.1 MATERIALS

- .1 Thermal Insulation: CAN/ULC-S702 and ASTM C612, preformed mineral fibre thermal insulation, water repellant and vapour permeable:
 - .1 Product, Semi Rigid Exterior wall: see Section 07 21 13
 - .2 Product, Batt Insulation: Roxul ComfortBatt
 - .3 Product, Curtain Wall Backpans: Roxul CurtainRock
 - .4 Thermal Resistance: as noted or illustrated on drawings.
 - .5 Other acceptable manufacturers offering functionally equivalent products:
 - .1 Thermafibre, by Owens Corning
- .2 Acoustic Insulation: CAN/ULC-S702 Type 1, preformed mineral fibre acoustic Insulation, water repellant and vapour permeable. Provides fire resistance to CAN/ULC-S114 and sound control to ASTM C423.
 - .1 Product, Semi Rigid Batt: Roxul AFB
 - .2 Other acceptable manufacturers offering functionally equivalent products:
 - .1 Thermafibre, by Owens Corning

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

- .1 Install insulation to manufacturer's written instructions.
- .2 Install in exterior walls spaces without gaps or voids. Do not compress insulation.
- .3 Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- .4 Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- .5 Coordinate work of this section with construction of air/vapour barrier seal specified in Section 07 27 13.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Foamed-in-place insulation in exterior framed walls at exterior wall crevices requiring a thermal seal.
- .2 Foamed-in-place insulation at junctions of dissimilar wall and roof materials to achieve a thermal and air seal with protective cover.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 - Board Insulation: Materials continuing the thermal barrier layer.
- .2 Section 07 27 13 - Air Barriers: Materials continuing the air barrier seal.
- .3 Section 07 50 11 - Single Ply Roofing - Loose Laid Ballasted - Conventional
- .4 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .5 Section 07 84 00 - Firestopping.
- .6 Section 07 92 00 - Joint Sealants: System perimeter sealant and back-up materials.
- .7 Section 08 41 13 - Aluminum Framed Entrances and Storefronts: Entrance doors, frames, and glazed lights.
- .8 Section 08 44 13 - Glazed Aluminum Curtain Walls: Functioning as a primary air seal.

1.3 REFERENCES

- .1 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S705.1-01 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification (including Amendment 3).
- .3 CAN/ULC-S705.2-05 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.
- .4 CUFCA (The Canadian Urethane Foam Contractors Association).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate work to ensure timely placement of insulation within construction spaces.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide product description, insulation properties, preparation requirements and details.

1.6 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section documented experience.
- .3 Installer Qualifications: Individuals specializing in performing the work of this section with documented experience, and licensed and certified by the SPF Quality Assurance Program used by CUFCA.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for flame and smoke requirements.

1.8 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Materials of this section are to be included in an **Envelope Mock-up**.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 43: Environmental conditions affecting products on site.
- .2 Do not install insulation when ambient temperature is lower than 21 degrees C.

Part 2 Products

2.1 MATERIALS

- .1 Insulation: CAN/ULC-S705.1, spray-applied rigid cellular polyurethane insulation, medium density.

2.2 ACCESSORIES

- .1 Primer: As required by insulation manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify work within construction spaces or crevices is complete prior to insulation application.

3.2 PREPARATION

- .1 Mask and protect adjacent surfaces from over spray or dusting.
- .2 Apply primer in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- .1 Apply insulation to CAN/ULC-S705.2 and manufacturer's written instructions.
- .2 Apply insulation by spray method, to a uniform monolithic density without voids.
- .3 Apply to achieve a thermal resistance R-noted on drawings.

- .4 Coordinate installation of protective covering specified in Section 09 21 16, to achieve fire rating required.
- .5 Patch damaged areas.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field inspection.
- .2 Inspection will include verification of insulation thickness and density.

3.5 PROTECTION OF FINISHED WORK

- .1 Do not permit subsequent construction work to disturb applied insulation.

3.6 SCHEDULES

- .1 Interior wall/roof junction.
- .2 Wall construction abutting differing above ceiling materials.
- .3 Exterior wall insulation in stud cavity.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Air leakage criteria for primary air seal building enclosure materials and assemblies.
- .2 Materials and installation methods supplementing primary air seal materials and assemblies.
- .3 Air seal materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.

1.2 RELATED SECTIONS

- .1 Section 04 26 13 – Veneer Masonry
- .2 Section 07 11 13 - Bituminous Dampproofing: Below grade dampproofing membrane functioning as an air seal.
- .3 Section 07 13 00 - Sheet Membrane Waterproofing
- .4 Section 07 21 13 - Board Insulation: Insulation directly adjacent to the air seal.
- .5 Section 07 21 16 – Blanket Insulation: Insulation directly adjacent to the air seal.
- .6 Section 07 84 00 - Firestopping: Fire stopping materials.
- .7 Section 07 92 00 - Joint Sealants: Sealant materials and installation techniques.
- .8 Section 07 50 11 – Single Ply Roofing – Loose Laid Ballasted - Conventional
- .9 Section 08 44 13 - Glazed Aluminum Curtain Walls: Functioning as a primary air seal.
- .10 Section 08 45 23 – Translucent Panel Wall and Roof Assemblies.
- .11 Section 08 41 13 - Aluminum Framed Entrances and Storefronts: Aluminum entrances and store fronts, functioning as a primary air seal.
- .12 Section 09 21 16 - Gypsum Board Assemblies: Functioning as a primary air seal substrate.
- .13 Section 09 91 10 - Painting: Air sealing porous materials on inside surfaces of exterior wall.

1.3 REFERENCES

- .1 ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants.
- .2 ASTM C1311-14 - Standard Specification for Solvent Release Sealants.
- .3 ASTM E283-04(2012) - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .4 ASTM E330/E330M-14 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 NABA (National Air Barrier Association) - Air Barrier Quality Assurance Program (QAP).

- .6 SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 DEFINITIONS

- .1 Air Barrier: A continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of a single material or a combination of materials to achieve the performance requirements.

1.5 PERFORMANCE REQUIREMENTS

- .1 Provide an air barrier assembly tested to NABA's approved testing protocol to provide air leakage results not to exceed (0.02 L/s sq m) 0.004 cfm/sq ft when subjected to a pressure differential of (75 Pa) 1.5 lb/sq ft.
- .2 Provide continuity of air seal materials and assemblies in conjunction with materials described in Section 07 92 00.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work of this section with all sections referencing this section.
- .2 Pre-installation Meetings: Convene two (2) weeks before starting work of this section.
- .3 Sequencing: Sequence work to permit installation of materials in conjunction with related materials and seals.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on material characteristics, performance criteria, limitations, and manufacture's installation guidelines.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work in accordance with the NABA Air Barrier Quality Assurance Program.
- .3 Maintain one (1) copy of document on site.
- .4 Contractor Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .5 Applicator Qualifications: Individuals specializing in performing the work of this section with documented experience. Contractor to submit names and work experience of approved applicators to perform the work of this section.

1.9 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.

- .2 Materials of this section are to be included in an **Envelope Mock-up**.
- .3 Construct typical exterior wall panel, (3 x 3 m) 10 x 10 ft, incorporating windowframe, sill and head, insulation, air barrier junction with roof membrane air seal; illustrating materials interface and seals.
- .4 Locate where directed by Consultant.
- .5 Approved mock-up may remain as part of the Work.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 43: Environmental conditions affecting products on site.
- .2 Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Sheet Seal Type 1: Self Adhered Wall/Roof Air/Vapour Barrier. Self-adhesive rubberized asphalt bonded to sheet polyethylene, regular temperature, nominal total thickness of (1mm) 40 mil.
 - .1 Product: Blueskin SA, manufactured by Bakor.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: Sopraseal Stick 1100 T, Manufactured by Soprema.
 - .2 Product: Perm-A-Barrier Wall Membrane, manufactured by Grace.
- .2 Sheet Seal Type 2: Self Adhered Thru-Wall Flashing. Self-adhesive rubberized asphalt bonded to sheet polyethylene, regular temperature, nominal total thickness of (1mm) 40 mil.
 - .1 Product: Blueskin TWF, manufacturing by Bakor.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: Sopraseal WFM, Manufactured by Soprema.
 - .2 Product: Perm-A-Barrier Wall Flashing, Manufactured by Grace.
- .3 Steel Sheet Type 3: Galvanized steel, Z275 (90) zinc coating, (0.6 mm) 24 gauge thick core steel.

2.2 SEALANTS

- .1 Sealants: Refer to Sealants 07 92 00.
- .2 Primer: Appropriate to application.
- .3 Substrate Cleaner: Non-corrosive, compatible with adjacent materials.

2.3 MASTICS AND TERMINATION SEALANTS

- .1 Mastic Adhesive Type 1: Bituminous mastic compatible with sheet seal and substrate, thick mastic of uniform knife grade consistency. Select product per recommendation by sheet membrane manufacturer.
- .2 Termination Sealant: Compatible with sheet seal and substrate, permanently non-curing. Select product per recommendation by sheet membrane manufacturer.

2.4 ACCESSORIES

- .1 Thinner and Cleaner for Butyl Neoprene Sheet: As recommended by sheet material manufacturer.
- .2 Attachments: Galvanized steel termination bars and anchors, (3 mm) 1/8 inch thick with waterproof sealant applied to top flange.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that surfaces and conditions are ready to accept the Work of this section.

3.2 PREPARATION

- .1 All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrate to provide an even plane. Strike masonry joints flush.
- .2 New concrete should be cured for a minimum of 14 days and must be dry before air/vapour barrier membranes are applied.
 - .1 Where curing compounds are used, they must be clear resin based without oil, wax or pigments.
 - .2 Clean and prime substrate surfaces to receive adhesive to manufacturers written instructions.
 - .3 Install steel sheet bridging over cracks and joints exceeding 13mm. Secure with flat head screws.

3.3 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 Adhesive or Primer for Sheet Type 1, 2, 3.
 - .1 Apply adhesive or primer for self-adhering membrane at rate recommended by manufacturer.
 - .2 Apply to all areas to receive transition sheet and / or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30-minute open time.
- .3 Transition Membrane (Self-Adhering)
 - .1 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 6 inch (150 mm) overlap at all end and side laps.
 - .2 Tie-in to window frames, aluminium screens, hollow metal door frames, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
 - .3 Promptly roll all laps and membrane with a counter top roller to effect seal.
 - .4 Ensure all preparatory work is complete prior to applying liquid applied air vapour barrier membrane.
- .4 Through-wall Flashing Membrane & Dampproof Course (Self-Adhering)

- .1 Apply through-wall flashing and dampproof coursing membrane in accordance with CSA A371-94 Masonry Construction for Buildings; along the base of masonry veneer walls, over windows, doors and other wall openings required to be protected.
- .2 Applications shall form a continuous flashing membrane and shall extend up a minimum of 200 mm up the back-up wall.
- .3 At the end of each day's work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
- .4 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. At locations where flashing terminates or intersects wall openings including door frames, "end dam" flashing to protect openings and redirect water out. Trim off excess as directed by the consultant.
- .5 Apply dampproof coursing membrane over slabs on grade, prepare and prime surfaces, align and position membrane between slab and masonry block work.
- .6 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls, self angles and other substrates to be protected, partially remove protective film and roll membrane over surface and up vertically.
- .7 Press firmly into place. Ensure minimum 150 mm overlap at all end and side laps. Promptly roll all laps and membrane to affect the seal.
- .8 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.
- .9 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
- .5 Air Barrier Membrane (Self-Adhering)
 - .1 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
 - .2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 150 mm overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to affect the seal.
 - .3 At the end of each day's work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
 - .4 Tie-in to window frames, aluminium screens, hollow metal door frames, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings. Refer to manufacturers' standard details.
 - .5 Ensure all projections, including wall ties, are properly sealed with a sealant application of liquid air seal mastic.
 - .6 Mechanically fasten membrane with securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.
 - .7 Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.

- .6 Install steel sheet bridging as noted in drawings and over all cracks and joints exceeding (6 mm) 1/4 inch; seal with sheet seal. Secure with flat head screws.
- .7 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field testing and inspection.
- .2 Owner will engage inspection services for air barrier and material installation to NABA Air Barrier Quality Assurance Program.
- .3 Provide written inspection report to Consultant.
- .4 Owner will provide inspection and testing reports for Contractor.
- .5 Owner will engage a third-party to perform water infiltration tests of air barrier system installations to NABA Air Barrier Quality Assurance Program:
 - .1 The Owner will pay the testing agent to perform five (5) air barrier assembly water test.
 - .2 Failed tests will require correction in air barrier system by contractor and retesting by the Owner.
 - .3 Any failed test will cause one (1) additional air barrier assembly to be tested.
 - .4 The Owner will pay for up to ten (10) water tests and retests in total. Any additional water test will be paid for by the contractor.

3.5 PROTECTION OF FINISHED WORK

- .1 Do not permit adjacent work to damage work of this section.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 11 00 - Wood Framing: Roof sheathing and framed openings.
- .2 Section 07 26 00 - Vapour Retarders: Continuation of wall vapour retarder.
- .3 Section 07 27 00 - Air Barriers: Continuation of wall air barrier system.
- .4 Section 07 62 00 - Sheet Metal Flashing and Trim: Edge and cap flashings.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.4-[M89], Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing.
 - .2 CAN/CGSB-37.5-[M89], Cutback Asphalt Plastic Cement.
 - .3 CAN/CGSB-51.32-[M77], Sheathing, Membrane, Breather Type.
 - .4 CAN/CGSB-51.34-[M86], Vapour Barrier Polyethylene Sheet, for Use in Building Construction.
- .2 Canadian Roofing Contractors' Association (CRCA)
 - .1 CRCA Roofing Specification Manual - 1997.
- .3 CSA Group (CSA)
 - .1 CSA A123.1/A123.5-[05(R2010)], Asphalt Shingles Made From Organic Felt and Surfaced With Mineral Granules/Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules.
 - .2 CAN/CSA-A123.2-[03(R2008)], Asphalt-Coated Roofing Sheets.
 - .3 CSA A123.3-[05(2010)], Asphalt Saturated Organic Roofing Felt.
 - .4 CAN3-A123.51-[M85(R2006)], Asphalt Shingle Application on Roof Slopes 1:3 and Steeper.
 - .5 CSA B111-[1974(R2003)], Wire Nails, Spikes and Staples.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [asphalt shingles] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit proof of manufacturer's CCMC listing and listing number.

- .3 Submit two (2) copies of WHMIS SDS in accordance with Section 01 35 29 - Health and Safety Requirements.

.3 Samples:

- .1 Submit duplicate samples of full size specified shingles.

.4 Sustainable Design Submittals:

- .1 Construction Waste Management:

- .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations.
 - .2 Remove only in quantities required for same day use.
 - .3 Store and protect asphalt shingles from nicks, scratches, and blemishes.
 - .4 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

1.5 EXTRA STOCK MATERIALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 All unused shingles remain property of Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Asphalt Shingles: CSA-A123.1/A123.5, Type I uniform or non-uniform thickness; UL Rating of C and Wind Resistance Label organic felt base, mineral granule surfaced type; 4.6 kg/sq m (95 lb/100 sq ft) weight; self sealing type; square tab; colour standard range as selected.
- .2 Eave (Ice Dam) Protection: CGSB 37-GP-56M, Sheet barrier of rubberized asphalt bonded to sheet polyethylene, 1 mm (40 mil) total thickness, with strippable treated release paper
- .3 Underlayment: [CAN/CGSB-51.32] Cellulose fibre building (Kraft) paper, water repellent breather type.

2.2 ACCESSORIES

- .1 Nails: to CSA B111 Standard round wire shingle type hot dipped zinc coated steel type, of sufficient length to penetrate 19 mm (3/4 inch) into roof sheathing.
- .2 Plastic Cement: to CAN/CGSB-37.5ASTM D2822 asphalt type with mineral fibre components, free of toxic solvents, capable of setting within twenty-four (24) hours at temperatures of 24 degrees C and 50% RH.
- .3 Lap Cement: to [CAN/CGSB-37.4] Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.
- .4 Ridge Vents: Plastic, extruded with vent openings that do not permit direct water or weather entry; flanged to receive shingles.

2.3 FLASHING MATERIALS

- .1 Sheet Flashings and Ridge Vents: Precoated steel, as specified in Section 07 62 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for asphalt shingles installation in accordance with manufacturer's written instructions.
 - .1 Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
 - .2 Verify roof openings are correctly framed.
 - .3 Verify deck surfaces are dry, free of ridges, warps, or voids.
- .2 Visually inspect substrate in presence of Departmental Representative.
- .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 REMOVAL OF EXISTING ROOFING

- .1 Remove existing roofing, flashings and underlay, and expose sheathing or shingle lath of roof.
- .2 Withdraw existing shingle and flashing nails, set those which break off. Leave surfaces free from dirt and loose material.
- .3 Departmental Representative to inspect roof sheathing.
- .4 Remove portion of sheathing affected by fungal or insect attack as directed by Departmental Representative. Contractor to allow for 5% of existing sheathing area to be replaced in base price.

- .5 Replace cut out portions of sheathing or lath with sheathing of equal sectional dimensions, and specified grade. Seat each end on rafter, with 25 mm bearing, and secure to rafter.

3.3 PREPARATION

- .1 Fill knot holes and surface cracks with latex filler at areas of bonded eave protection. Cover knot holes with sheet metal.
- .2 Broom clean deck surfaces under eave protection and underlayment.

3.4 INSTALLATION - EAVE (ICE DAM) PROTECTION

- .1 Place eave edge and gable edge metal flashings tight with fascia boards. Weather lap joints 50 mm (2 inches) and seal with plastic cement. Secure flange with nails spaced 600 mm (24 inches) on centre.
- .2 Apply rubberized asphalt/polyethylene sheet eave protection in accordance with manufacturer's written instructions.
- .3 Extend eave protection membrane minimum 1200 mm (4 ft) up-slope beyond interior face of exterior wall.

3.5 INSTALLATION - PROTECTIVE UNDERLAYMENT

- .1 Place one ply of underlayment over area not protected by eave protection, with ends and edges weather lapped minimum 150 mm (6 inches). Stagger end laps of each consecutive layer. Nail in place.
- .2 For slopes less than 1.3 (4:12): place a second ply of underlayment over first layer with ends and edges weather lapped minimum 150 mm (6 inches). Stagger end laps of each consecutive layer. Nail in place.
- .3 Install protective underlayment perpendicular to slope of roof and weather lap minimum 150 mm (6 inches) over eave protection.
- .4 Weather lap and seal watertight with plastic cement items projecting through or mounted on roof.

3.6 INSTALLATION - VALLEY PROTECTION

- .1 Place one layer of sheet metal flashings, minimum 600 mm (24 inches) wide, entered over open valleys and crimped to guide water. Weather lap joints minimum 50 mm (2 inches). Nail in place minimum 450 mm (18 inches) on centre, 25 mm (1 inch)] from edges.

3.7 INSTALLATION - METAL FLASHING AND ACCESSORIES

- .1 Weather lap joints minimum 50 mm (2 inches) and seal weather tight with plastic cement.
- .2 Secure in place with nails at 600 mm (24 inches) on centre. Conceal fastenings.
- .3 Flash and seal work weather tight, projecting through or mounted on roofing with plastic cement.

3.8 INSTALLATION - ASPHALT SHINGLES

- .1 Do asphalt shingle work to CRCA Specification except where specified otherwise.
- .2 Place shingles in straight coursing pattern with 125 mm (5 inch) weather exposure to produce [double] [triple] thickness over full roof area. Provide double course of shingles at eaves.
- .3 Project first course of shingles 19 mm (3/4 inch) beyond fascia boards.
- .4 Extend shingles 13 mm (1/2 inch) beyond face of gable edge fascia boards.
- .5 Extend shingles on one slope across valley and fasten. Trim shingles from other slope 50 mm (2 inches) from valley centre line to achieve closed cut valley, concealing the valley protection.
- .6 Cap hips and ridges with individual shingles, maintaining 125 mm (5 inch) weather exposure. Place to avoid exposed nails.
- .7 Coordinate installation of roof mounted components or work projecting through roof with weather tight placement of counter flashings.
- .8 Complete installation to provide weather tight service.

3.9 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.

3.10 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 31 13 Asphalt Shingles: Edge and fascia flashings
- .2 Section 07 46 13 Preformed Metal Siding: Siding system trim.
- .3 Section 07 61 00 Sheet Metal Roofing: Roof system trim.

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 621-[02] Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems current.
- .3 ASTM International
 - .1 ASTM A 653/A 653M-[15e1], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A 755/A 755M-[16e1] Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - .3 ASTM D 1970/D 1970M-[15a] Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - .4 ASTM D 4587-[11] Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - .5 ASTM F 1667-[15] Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.32-[M77], Sheathing, Membrane, Breather Type.
- .5 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
- .6 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI S8-2008 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
 - .2 CSSBI B17-2002 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.

- .3 CSSBI Sheet Steel Facts #12 [2003] Fastener Guide for Sheet Steel Building Products.
- .7 CSA Group
 - .1 CSA A123.22-[08(2013)] Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .9 Sheet Metal and Air Conditioning Contractors Association of North America (SMACNA)
 - .1 Architectural Sheet Metal Manual (2012)
 - .2 Residential Sheet Metal Guidelines (2001)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature including product specifications and technical data sheets for sheet metal flashing fasteners and accessory materials. Include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit [two] copies WHMIS SDS - Material Safety Data Sheets in accordance with Section 01 35 2- Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit shop drawings only for sheet metal flashing and trim items that differ from those indicated in Contract Documents.
 - .2 Indicate sheet thickness, flashing dimensions and fastenings. Include anchorage, expansion joints and other provisions for thermal movement.
 - .3 Submit manufacturer's catalogue cut sheets for manufactured items.
- .4 Samples:
 - .1 Submit 50 x 50 mm samples of each type of sheet metal material, finishes and colour.

1.4 PRE-INSTALLATION MEETING

- .1 Include sheet metal flashing and trim on agenda of pre-installation meetings of affected sections.

1.5 MOCK-UPS

- .1 Include flashings in mock-ups as specified for work of other affected sections.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 BASE SHEET METAL MATERIALS

- .1 Provide sheet metal in base metal thickness specified. Where no thickness specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than the thickness required by the authority having jurisdiction.
- .2 Zinc coated steel sheet: 0.607 mm (24 Gauge) thickness, commercial quality to ASTM A 653/A 653M, with Z275 designation zinc coating.

2.2 PREFINISHED STEEL SHEET

- .1
- .2 Prefinished steel with factory applied primer and polyvinyl chloride heat-cured topcoat.
 - .1 Class F1S.
 - .2 Barrier Series colour selected by Departmental Representative from manufacturer's full range.
 - .3 Specular gloss: 30units +/- 5 in accordance with ASTM D 523.
 - .4 Coating thickness: not less than 200micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D 45878 as follows:
 - .1 Cycle #4 General Metal Coatings.
 - .2 Exposure period: 2000hours.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Pourable sealer: proprietary two-part polyurethane pourable sealer designed for sealing penetration pockets.
- .3 Self-adhesive membrane underlay and tie-in membrane for metal flashings: To CSA A12 or ASTM D 1970, minimum 1 mm (40 mil) thickness.
- .4 Sealants: In accordance with Section 07 92 00, in colour to match flashing finish colour.
- .5 Cleats and hook strips: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
 - .1 Provide continuous hook strip at outside of parapets.

- .6 Nails: of same material as sheet metal, [ring thread] flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Screws: of same material as sheet metal, Suitable for substrate and material being fastened, galvanized coloured nylon head, neoprene washer.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate sheet steel flashings and other sheet steel work and SMACNA architectural details or as indicated.
- .2 Form pieces in 2400 mm maximum lengths.
 - .1 Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm.
 - .1 Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 0.76 mm (22 Gauge) thick galvanized prefinished steel.

2.6 PANS

- .1 Form pans to receive roofing plastic from 0.76 mm (22 gauge) , galvanized , prefinished steel sheet metal with minimum 75 mm upstand above finished roof and 100mm continuous flanges with no open corners.
 - .1 Rivet joints.
 - .2 Make pans minimum 50 mm wider than member passing through roof membrane.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details or as detailed.
- .2 Use concealed fastenings except where approved before installation.

- .3 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
 - .2 Provide self-adhesive membrane to tie into adjacent assemblies.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Caulk flashing at cap flashing with sealant.
- .7 Install pans, where shown around items projecting through roof membrane.
- .8 Where flashing installed with mechanical fasteners, install fasteners in slots or oversize holes to allow expansion and contraction of flashings.
- .9 Provide isolation coating or impervious self-adhesive membrane to separate aluminum items from concrete and masonry.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fireproof firestopping (fire-safing) materials and accessories, including firestopping of mechanical and electrical service penetrations.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 07 27 00 - Air Barriers: Air barrier materials to adjacent insulation.
- .3 Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.
- .4 Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC): Mechanical work requiring firestopping.
- .5 Division 26 – Electrical: Electrical work requiring firestopping.

1.3 REFERENCES

- .1 CAN/ULC-S101-07 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S115m-05 - Standard Method of Fire Tests of Firestop Systems.
- .4 ULC - Building Materials Directory.

1.4 DEFINITIONS

- .1 Firestopping (Fire-safing): A sealing or stuffing material or assembly placed in spaces between building materials to arrest the movement of smoke, heat, gases, or fire through wall or floor openings.

1.5 SYSTEM DESCRIPTION

- .1 Firestopping systems installed to resist spread of fire and passage of smoke and other gases at penetrations through fire resistance rated wall floor assemblies, materials and components.

1.6 PERFORMANCE REQUIREMENTS

- .1 Materials, accessories and application procedures listed by ULC, or tested to CAN/ULC-S115m to comply with building code requirements.
- .2 Firestopping Materials: CAN/ULC-S101 to achieve a fire rating as noted on Drawings

1.7 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.8 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance and limitation criteria, as specified..
- .3 System Design Listings: Submit system design listings, including illustrations from a qualified testing and inspection agency that is applicable for each firestop configuration.

1.9 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special preparation and installation requirements.
- .3 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.10 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .3 Contractor Qualifications: Company specializing in performing the work of this section, as follows:
 - .1 Licensed by the province or local authority where applicable.
 - .2 Installers who have successfully completed comparable scale projects.
 - .3 Contractor to submit the name and experience profile for each installer working on site.
- .4 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.

1.11 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Provide mock-up of applied firestopping assemblies.
- .3 Apply firestop material to a representative penetrated masonry, stud wall, and concrete substrate surface.
- .4 Obtain Consultant's acceptance of mock-up before start of Work.
- .5 Retain and maintain accepted mock-ups during construction in undisturbed condition as a standard for judging completed work.
- .6 Locate where directed by Consultant.
- .7 Approved mock-up may remain as part of the Work.

1.12 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.13 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.

- .2 Deliver firestopping products in original, unopened containers with labels intact and legible, identifying product and manufacturer.
- .3 Store and handle firestopping materials to manufacturer's instructions.

1.14 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not apply materials when temperature of substrate material and ambient air is below manufacturer's recommendations.
- .3 Maintain this minimum temperature before, during, and for three (3) days after installation of materials.
- .4 Provide ventilation to manufacturer's instructions in areas to receive solvent cured materials.

Part 2 Products

2.1 MANUFACTURERS

- .1 Provide firestopping and smoke seal systems only from manufacturers publishing ULC Listed or UL Certified for Use in Canada System Designs tested in accordance with CAN/ULC-S115m:
 - .1 Acceptable Manufacturers: A/D Fire, Grace, Hilti, and 3M.

2.2 ACCEPTABLE PRODUCTS

- .1 Selection of appropriate system to maintain required fire resistance rating is the responsibility of the Installer. All systems or EJs are to be submitted for review. Systems must be asbestos-free.
- .2 Selection to be based on specified performance requirements and is limited to ULC Listed or UL Certified for Use in Canada System Designs tested in accordance with CAN/ULC S115m.
- .3 Substitution of products, components or accessories forming part of a System Design is not acceptable, unless accompanied by an EJ (Engineering Judgement) or EFRRA from the system manufacturer.

2.3 ACCESSORIES

- .1 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.
- .2 Dam Material: Permanent.
 - .1 Sheet metal.
- .3 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- .4 Premanufactured fire-safing products for servicing bundled data cabling are supplied and installed under Division 26 – Electrical.

2.4 FINISHES

- .1 Colour: Red, typical; Dark grey, for visible finished areas.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this section.
- .3 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- .2 Remove incompatible materials which may affect bond.
- .3 Install damming materials to arrest liquid material leakage.

3.3 APPLICATION

- .1 Apply primer and firestopping materials to manufacturer's written instructions.
- .2 Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- .3 Apply firestopping material in sufficient thickness to achieve rating, and to uniform density and texture.
- .4 Compress fibred material to achieve a density of 40% of its uncompressed density.
- .5 Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- .6 Dam Material: Dam material to remain.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field inspection.
 - .1 Contractor to arrange and pay for field inspection and reporting from manufacture's representative.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect adjacent surfaces from damage by material installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Preparing substrate surfaces.
- .2 Sealant and joint backing.
- .3 Structural sealant for glazing assemblies.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Sealants required in conjunction with precast, and cast-in-place concrete.
- .2 Section 07 27 13 - Modified Bituminous Sheet Air Barrier: Sealants required in conjunction with air barrier.
- .3 Section 07 62 00 - Sheet Metal Flashing And Trim: Sealants required in conjunction with metal flashings.
- .4 Section 07 84 00 - Firestopping: Sealants required in conjunction with firestopping.
- .5 Section 08 11 13 - Metal Doors and Frames: Sealants required in conjunction with door frames.
- .6 Section 08 41 13 - Aluminum Frame Entrances: Sealant required in conjunction with frame abutments.
- .7 Section 08 80 50 - Glass and Glazing: Sealants required in conjunction with glazing methods.

1.3 REFERENCES

- .1 ASTM C509-06 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
- .2 ASTM C834-10 - Standard Specification for Latex Sealants.
- .3 ASTM C919-08 - Standard Practice for Use of Sealants in Acoustical Applications.
- .4 ASTM C920-11 - Standard Specification for Elastomeric Joint Sealants.
- .5 ASTM C1184-05 - Standard Specification for Structural Silicone Sealants.
- .6 ASTM C1193-09 - Standard Guide for Use of Joint Sealants.
- .7 ASTM C1311-10 - Standard Specification for Solvent Release Sealants.
- .8 ASTM C1330-02(2007) - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .9 ASTM C1401-09a - Standard Guide for Structural Sealant Glazing.
- .10 ASTM E330-02(2010) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .11 CGSB 19-GP-5M-84 - Sealing Compound, One Component, Acrylic Base, Solvent Curing.

- .12 CGSB-19-GP-14M-1984 - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

1.4 PERFORMANCE REQUIREMENTS

- .1 Sealant Design: Design structural sealant to withstand specified loads without breakage, loss, failure of seals, product deterioration, and other defects.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with all sections referencing this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, colour availability.
- .3 Structural Sealant Joint Design: Confirmation design data provided by installer has been reviewed and approved by sealant manufacturer.
- .4 Shop Drawings: Indicate sealant joints and dimensions, materials, structural bite, glue-line thickness, joint profile, and support framing.

1.7 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.
 - .1 Indicate special procedures, surface preparation, perimeter conditions requiring special attention, field quality control testing.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform work to sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- .3 Perform sealant application work to ASTM C1481 and ASTM C1193.
- .4 Perform structural sealant application work to ASTM C1401.
- .5 Perform acoustical sealant application work to ASTM C919.
- .6 Maintain one (1) copy of each document on site.
- .7 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .8 Applicator Qualifications: Installer specializing in performing the work of this section with minimum documented experience and approved by the manufacturer. Contractor to submit names and work experience of approved applicators to perform the work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- .3 VOC Limitations: for all materials supplied by this Section, the total VOC content must be less than or equal to 250 g/L, less water, when tested to ASTM D2369.
- .4 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.

1.10 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide a four (4) year extended warranty to include coverage for failure to meet specified requirements.
- .3 Warranty: Include coverage for replacements parts and labour.

Part 2 Products

2.1 SEALANTS

- .1 Siliconized Interior Acrylic Latex Sealant (Type S1): ASTM C9834, Type OP, Grade NT; single component, non-staining, non-bleeding, non-sagging; colour as selected.
 - .1 Use: General purpose interior and exterior caulking and as a back-bedding glazing compound. Acoustical seal in the construction of interior walls, ceilings and floors. Suitable for use on vinyl, aluminum and wood siding as well as on bathroom and kitchen fixtures.
 - .2 Elongation Capability +/- 25%.
 - .3 Product: Tremflex 834, manufactured by Tremco.
 - .4 Acceptable Alternate Product: PECORA AC-20+silicone.
- .2 High-modulus Silicone Sealant (Type S2): ASTM C920-14 - Standard Specification for Elastomeric Joint Sealants., Type S, Grade NS, Class Class 50, Use NT, M, G, A, O; single component, moisture curing, non-staining, non-bleeding, non-sagging; colour: as selected
 - .1 Product: Spectrem 1, manufactured by Tremco.
 - .2 Acceptable Alternate Product: PECORA 890NST.
- .3 Medium-modulus Silicone Sealant (Type S3): ASTM C920-14 - Standard Specification for Elastomeric Joint Sealants.; Type S, Grade NS; Class 50; Use NT, M, G, A, and O; single component, non-sagging, non-staining, non-bleeding, paintable; colour: as selected
 - .1 Use: Two-sided structural glazing; Perimeter and weather seals; Cap, heel and toe beads; Curtain wall or window joints. Used on substrates such as aluminum, glass, steel, painted metal, plastic, stone, concrete and brick. All structural glazing applications must be reviewed and approved by manufacturer prior to application.
 - .2 Product: Spectrem 2, manufactured by Tremco.

- .3 Acceptable Alternate Product: PECORA 895NST
- .4 Single Component Urethane Sealant (Type S4): ASTM C920, Type S, Grade NS, Class 50, Uses T, NT and I; Immersible, single-component, non-sag, traffic-and nontraffic-use, urethane joint sealant.
 - .1 Use: Expansion and control joints, precast concrete panel joints, perimeter caulking (windows, door, panels), aluminum, masonry and vinyl siding.
 - .2 Product: Dymonic 100, manufactured by Tremco.
- .5 Single Component Urethane Sealant (Type S5): ASTM C920 Type S, Grade NS, Class 25, Uses NT, M, A, O; single component, moisture curing, nonstaining, non-bleeding, color as selected.
 - .1 Uses: Expansion and control joints in pre-cast tilt-up concrete, curtain wall joints and perimeter caulking around windows and doors.
 - .2 Product: Dymonic, manufactured by Tremco.
 - .3 Acceptable Alternate Product: PECORA Dynatrol I-XL.
- .6 Multi-Component Urethane Sealant (Type S6): ASTM C920 Type M, Grade P, Class 25, Uses T; self leveling, multi-component, chemical curing, non-staining, nonbleeding, color as selected.
 - .1 Uses: A self-leveling joint sealant for use in any traffic rated horizontal expansion or control joint. Used in parking garages, plazas, terrace decks, floors and sidewalk joints.
 - .2 Product: THC 900/901, manufactured by Tremco.
- .7 Synthetic Rubber Sealant (Type S7): single component, non-skinning, non-hardening synthetic rubber sealant.
 - .1 Uses: Acoustical sealing of drywall partitions, corridors and party walls. This sealant also is used as a lap joint and perimeter sealant for polyethylene vapor barriers over fiberglass batt or other insulations and may be used in contact with polystyrene.
 - .2 Product: Acoustical Sealant, manufactured by Tremco.
 - .3 Acceptable Alternate Product: PECORA AIS-919.
- .8 Sanitary Silicone Sealant (Type M): ASTM C920, Type S, Grade NS, use NT, G, A, and O; single component, acetoxo curing, non-sagging, non-staining, mildew resistant; colour as selected.
 - .1 Uses: A weathertight seal to glass, metal, porcelain, ceramic and most painted surfaces. Clear with fungicide for use in bathrooms, spas and similar applications where joints need protection against fungi and bacteria.

2.2 STRUCTURAL SEALANT

- .1 Structural Silicone Sealant (Type SS1): ASTM C920, Type S, Grade NT, G, A and O; Class A, Type 2; ASTM C 1184, Use G and O.
 - .1 Use: Two and Four-sided structural glazing.
 - .2 Product: Proglaze SSG, manufactured by Tremco.

2.3 ACCESSORIES

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM C1330; round, closed cell polyethylene foam rod; oversized 30 to 50% larger than joint width.
- .4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- .5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.
- .6 Setting Blocks and Spacers: Compatible with silicone sealant and recommended by sealant manufacturer.

2.4 COLOURS

- .1 Unless indicated otherwise, in respective technical specification sections, colour selection is to be by Architect, from standard range.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that joint openings and substrate surfaces are clean, dry, and free of frost and ready to receive work.
- .3 Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- .1 Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2 Clean and prime joints to sealant manufacturer's written instructions.
- .3 Perform preparation to sealant manufacturer's written instructions.
- .4 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- .1 Install sealant to sealant manufacturer's written instructions.
- .2 Measure joint dimensions and size materials to achieve 2:1 width/depth ratios.
- .3 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .4 Install bond breaker where joint backing is not used.
- .5 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .7 Tool joints as detailed concave.

3.4 STRUCTURAL SEALANT INSTALLATION

- .1 Site install glass panels specified in Section 08 80 50 to aluminum curtain wall framing specified in Section 08 44 13.

- .2 Prepare substrates and apply silicone sealant to manufacturer's written instructions and reviewed Shop Drawings.
- .3 Install sealant without gaps, twisting, stretching, or puncturing backing material. Ensure uniform depth to achieve correct profile, coverage, and performance.
- .4 Use temporary glass supports to retain glass panels while sealant is applied and allowed to cure.
- .5 Provide concave, smooth, uniform, sealant finish. Eliminate air pockets and ensure complete contact on both sides of joint opening.

3.5 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field testing .
- .2 Joint Sealants: Perform adhesion tests to manufacturer's written instructions and ASTM C1193, Method A - Field-Applied Sealant Joint Hand Pull Tab.
 - .1 Perform test seven (7) days after installation at a rate of one test every (100 m) 300 ft of installed sealant.
- .3 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.
- .4 Maintain test log and submit report to Architect indicating tests, locations, dates, results, and remedial actions.

3.6 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean adjacent soiled surfaces.

3.7 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Remove masking tape and excess sealant.
- .3 Protect sealants until cured, remove temporary glass supports.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Pressed steel door frames.
- .2 Hollow metal doors.
- .3 Interior glazed light frames.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-in-Place Concrete; Concrete walls.
- .2 Section 04 04 05 - Mortar and Masonry Grout: Masonry grout fill of metal frames.
- .3 Section 04 04 15 - Masonry Anchorage and Reinforcement: framing anchoring.
- .4 Section 04 04 25 - Masonry Units: masonry walls.
- .5 Section 07 92 00 - Joint Sealants.
- .6 Section 08 71 00 - Door Hardware – Common Requirements: Door Hardware, weatherstripping and silencers.
- .7 Section 08 80 50 – Glass and Glazing.
- .8 Section 09 21 16- Gypsum Board Assemblies.
- .9 Section 09 91 10 - Painting: Field painting of doors.
- .10 Division 22 – Plumbing: Louvres.

1.3 REFERENCES

- .1 ASTM A653/A653M-10 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C578-10a - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .3 ASTM E90-09 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .4 ASTM E413-10 - Classification for Rating of Sound Insulation.
- .5 CAN4-S104-M80 (R1985) - Fire Tests of Door Assemblies.
- .6 CAN4-S105-85 (R1992) - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .7 CAN/ULC-S701-11 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .8 CAN/ULC-S702-09 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .9 CAN/ULC-S704-11 - Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .10 CSA-G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .11 CSA-W59-03 (R2008) - Welded Steel Construction (Metal Arc Welding).

- .12 CSDMA (Canadian Steel Door Manufacturers Association).
 - .1 Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2000.
 - .2 Selection and Usage Guide for Commercial Steel Doors and Frames, 2009.
- .13 DHI A115.16-1994 - Installation Guide For Doors And Hardware.
- .14 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2010 Edition.
- .15 NFPA 252 - Fire Tests of Door Assemblies (2008 Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with frame opening construction, door, and hardware installation.
- .3 Sequencing: Sequence installation to ensure hardware wiring connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Indicate door and frame configurations and finishes, location of cut-outs for hardware reinforcement.
- .3 Shop Drawings:
 - .1 Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.
 - .2 Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, louvers, and finishes.

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.
- .3 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

- .1 Conform to requirements of CSDMA.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.

1.8 REGULATORY REQUIREMENTS

- .1 Fire Rated Door and Frame Construction: Labelled and listed to CAN4-S104 and NFPA 252.
- .2 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage.
- .3 Store in vertical position, spaced with blocking to permit air circulation between components.
- .4 Store materials on planks or dunnage, out of water and covered to protect from damage.
- .5 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc-rich primer.

1.10 WARRANTY

- .1 Provide extended warranty to include coverage for failure to meet specified requirements, to the following term:
 - .1 Exterior Doors: Four (4) Years
 - .2 Interior Doors: Four (4) Years
- .1 Provide warranty to include coverage for failure to meet specified requirements.

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel: Galvanized steel to ASTM A653/A653M, commercial grade (CS), Type B.
 - .1 Exterior Doors: coating designation G90 (Z275).
 - .2 Interior Doors: Coating designation G40 (Z120).
- .2 Reinforcement channel: To CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75 (A25).

2.2 DOOR CORE MATERIALS

- .1 Honeycomb Core: Structural small cell 25.4 mm (1 inch) maximum kraft paper honeycomb; weight 36.3 kg (80 lb) per ream minimum, density 16.5 kg/cu m (1.03 lbs/cu ft) minimum, sanded to required thickness.
- .2 Polystyrene Core: ASTM C578, Type 1, rigid extruded fire retardant, closed cell board, density 16 kg/cu m (1.0 lbs/cu ft) thermal value minimum of RSI 1.0 (R 5.9) per door.
- .3 Polyisocyanurate Core: ASTM C591, Type I, rigid modified polyisocyanurate, closed cell board, 32 kg/cu m (2.0 lbs/cu ft), thermal value minimum of RSI 1.9 (R 11) per door.

2.3 ADHESIVES

- .1 Cores and Steel Components: Heat resistant, structural reinforced epoxy, resin based adhesive.
- .2 Lock Seam: Reinforced epoxy resin, high viscosity, thicksotropic sealant.

2.4 PRIMERS

- .1 Primer: Rust inhibitive touch-up only.

2.5 ACCESSORIES

- .1 Door Silencers: Single stud rubber/neoprene.
- .2 Exterior Top Caps: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .3 Frame Thermal Breaks: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .4 Removable Glazing Stops: Formed galvanized steel channel, minimum 16 mm (5/8 inch) high, accurately fitted, butted at corners and fastened to frame sections with counter-sunk tamper proof sheet metal screws.
- .5 Bituminous Coating: Fibred asphalt emulsion.
- .6 Weatherstripping: Specified in Section 08 71 00 - Door Hardware – Common Requirements.
- .7 Glass: As specified in Section 08 80 50.

2.6 FABRICATION - DOORS

- .1 Exterior Doors: Laminated core construction.
- .2 Interior Doors: Laminated core construction.
- .3 Longitudinal Edges: mechanically interlocked, tack welded with no visible edge seams.
- .4 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .5 Reinforce for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware.
- .6 Top and Bottom Channels: Inverted, recessed, welded steel channels.
- .7 Exterior Door: Flush PVC top caps.
- .8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.7 LAMINATED CORE CONSTRUCTION

- .1 Exterior Doors: Both face sheets 2.0 mm 16 gauge steel, with polyisocyanurate core, laminated under pressure to face sheets.
- .2 Interior Doors: Both face sheets 1.2 mm 18 gauge steel with honeycomb core or polystyrene core (for fire rated doors up to 3 hours), laminated under pressure to face sheets.

2.8 FABRICATION - FRAMES

- .1 Exterior Frames: 2.0 mm 14 gauge thick base metal thickness.
 - .1 Welded or knock-down frame types may be used for fire rated openings up to and including 3 hours. Gypsum board slip on types may only be used for openings rated less than 3 hours.
 - .2 Frames: Welded type construction thermally broken.
 - .3 Transom Frames, Sidelight and Window Assemblies: Welded type construction thermally broken.

- .2 Interior Frames: 1.6 mm 16 gauge thick base metal thickness.
 - .1 Door Frames and Window Assemblies: Welded type construction.
 - .2 Transom Frames: welded type construction.
 - .3 Sidelight Assemblies: Welded type construction.
- .3 Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- .4 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier. Provide mortar guard boxes.
- .5 Reinforce frames wider than 1200 mm with roll formed steel channels fitted tightly into frame head, flush with top.
- .6 Prepare frames for silencers. Provide three (3) single silencers for single doors and mullions of double doors on strike side. Provide two (2) single silencers on frame head at double doors without mullions.
- .7 Configure exterior frames with special profile to receive recessed weatherstripping.
- .8 Attach fire rated label to each fire rated door unit.
- .9 Fabricate frames to suit masonry wall coursing with 75 mm head member.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable; check floor area within path of door swing for flatness.
- .3 Verify doors and frames are correct size, swing, rating and opening number.
- .4 Remove temporary shipping spreaders.

3.2 INSTALLATION

- .1 Install doors and frames to CSDMA.
- .2 Install fire-rated doors and frames in accordance with NFPA 80, and local authority having jurisdiction.
- .3 Coordinate with masonry , gypsum board , and concrete wall construction for anchor placement.
- .4 Coordinate installation of glass and glazing.
- .5 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .6 Set frames plumb, square, level and at correct elevation.
- .7 Secure anchorages and connections to adjacent construction.
- .8 Brace frames rigidly in position while building-in. Install wood spreaders at third points of frame rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm in width.
- .9 Remove wood spreaders after frames have been built-in.

- .10 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
- .11 Install doors, and hardware in accordance with hardware templates and manufacturer's instructions.
- .12 Adjust operable parts for correct clearances and function.
- .13 Install louvers, glazing and door silencers.
- .14 Finish paint as specified in Section 09 91 10.
- .15 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Diagonal Distortion: 3mm measured with straight edges, crossed corner to corner.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Flush wood transom panels and doors; flush configuration; non-rated and fire rated.

1.2 RELATED SECTIONS

- .1 Section 08 11 13 - Standard Metal Doors and Frames
- .2 Section 08 71 00 - Door Hardware -Common Requirements.
- .3 Section 08 80 50 - Glass and Glazing.
- .4 Section 09 91 10 - Painting: Site touch up of doors.

1.3 REFERENCES

- .1 ANSI A135.4-2004 - Basic Hardboard.
- .2 ASTM E413-10 - Classification for Rating of Sound Insulation.
- .3 AWMAC - Architectural Woodwork Standards (AWS) – 1st Edition, 2009.
- .4 CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies.
- .5 CAN4-S105M-85(R1992) - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .6 CHPVA (Canadian Hardwood Plywood and Veneer Association).
- .7 HPVA (Hardwood Plywood and Veneer Association).
- .8 NEMA LD3-2005 - High Pressure Decorative Laminates (HPDL).
- .9 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2010 Edition.
- .10 NFPA 252 - Fire Tests of Door Assemblies (2008 Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with door opening construction, door frame and door hardware installation.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- .3 Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria.
- .4 Samples:

- .1 Submit [one (1)] samples of door veneer, 300 x 300 mm (12x12inch) in size illustrating finished product.

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.

1.7 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform work in accordance with AWMAC Quality Standards, Custom Grade.
- .3 Finish doors in accordance with AWMAC Quality Standards to finish identified in schedule.
- .4 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience and a member in good standing with AWMAC.

1.9 REGULATORY REQUIREMENTS

- .1 Fire Rated Door and Panel Assembly: Labelled and listed to CAN4-S104.
- .2 Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.10 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Package, deliver and store doors in accordance with AWMAC.
- .3 Accept doors on site in manufacturer's packaging. Inspect for damage.
- .4 Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.11 WARRANTY

- .1 Section 01 78 26: Warranties.
- .2 Provide extended warranty to include coverage for failure to meet specified requirements, to the following term:
 - .1 Interior Doors: Five (5) years.
 - .2 Include coverage for warping beyond specified installation tolerances, telegraphing core construction, delamination of veneer, and defective materials.

Part 2 Products

2.1 MANUFACTURERS

- .1 Baillargeon; Product: Intense.
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Lambton; Product: similar quality product.
 - .2 Lynden; Product: similar quality product.
- .3 Substitutions: Not permitted.

2.2 DOOR LEAF TYPES

- .1 Interior Doors: 1 ¾ inch thick; solid core construction, fire , acoustic rated as indicated.
- .2 Transom Panels: 1 ¾ inch thick, face veneer to book match, door below.

2.3 DOOR LEAF CONSTRUCTION

- .1 Core (Solid, Non-Rated): AWMAC Section 1300, Type PC - Particleboard.

2.4 DOOR FACING

- .1 Veneer Facing (Interior Doors): AWMAC Custom quality species wood, quartered, with book matched grain, end match transoms for transparent finish.
 - .1 Species: Eastern White Birch

2.5 ADHESIVE

- .1 Facing Adhesive: Type II - water resistant.

2.6 ACCESSORIES

- .1 Glazing Stops: Permanent, rectangular shape, mitred corners; prepared for countersink style finish nail and wood filler.

2.7 FABRICATION

- .1 Fabricate non-rated doors in accordance with AWMAC Quality Standards requirements.
- .2 Fabricate fire rated doors in accordance with AWMAC Quality Standards and to ULC requirements. Attach fire rating label to door.
- .3 Sound Rating for Single Door Leaf and Frame Assembly: ASTM E413, minimum STC 50; where noted on door schedule.
- .4 Provide lock blocks at top of door for closer and lock edge for hardware reinforcement.
- .5 Vertical Exposed Edge of Stiles: Of same species as veneer facing, transparent finish.
- .6 Fit door edge trim to edge of stiles after applying veneer facing.
- .7 Bond edge banding to cores.
- .8 Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Provide solid blocking for through bolted hardware.
- .9 Factory fit doors for frame opening dimensions identified on shop drawings.

- .10 Cut and configure exterior door edge to receive recessed weather stripping devices.
- .11 Provide edge clearances in accordance with AWMAC.

2.8 FINISHES

- .1 Factory finish doors in accordance with manufacture's standard quality.
- .2 Seal door top edge with clear sealer to match door facing.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable.
- .3 Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- .1 Install non-rated doors in accordance with AWMAC Quality Standards requirements.
- .2 Install fire rated doors to NFPA 80.
- .3 Trim non-rated door width by cutting equally on both jamb edges.
- .4 Trim door height by cutting bottom edges to a maximum of $\frac{3}{4}$ inch. Trim fire door height at bottom edge only, in accordance with fire rating requirements.
- .5 Machine cut for hardware.
- .6 Coordinate installation of doors with installation of frames specified in Section 08 11 13 and hardware specified in Section 08 71 00.
- .7 Coordinate installation of glass and glazing with Section 08 80 50.

3.3 INSTALLATION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Conform to AWMAC requirements for fit and clearance tolerances.
- .3 Conform to AWMAC Section 1300 requirements for maximum diagonal distortion.

3.4 ADJUSTING

- .1 Adjust door for smooth and balanced door movement.
- .2 Adjust closer for full closure.

3.5 SCHEDULES

- .1 Refer to door schedule on drawings for location of product.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 00 - Common Work Results for Masonry
- .2 Section 09 21 16 - Gypsum Board Assemblies.
- .3 Section 09 30 13 - Ceramic Tiling.

1.2 REFERENCE STANDARDS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for access door components and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
 - .2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.
- .4 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit one (1) of each type of hand entry access door.
 - .4 Submit one 300 x 300 mm corner sample of each type of body entry door.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00 – Material and Equipment and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect access doors from nicks, scratches, and blemishes.
 - .3 Apply temporary protective coating to finished surfaces. Remove coating after installation.
 - .1 Use coatings in accordance with manufacturer's written instructions that are easily removable.
 - .2 Leave protective coating in place until final cleaning of building.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCESS DOORS

- .1 Sizes: as follows unless indicated:
 - .1 For body entry: 600 x 600 mm minimum.
 - .2 For hand entry: 300 x 300 mm minimum.
- .2 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.
- .3 Materials:
 - .1 Tiled or marble surfaces: stainless steel with brushed satin.
 - .2 Other areas: prime coated steel.
 - .1 Primer: VOC limit 100 g/L maximum to GS-11 .

2.2 EXCLUSIONS

- .1 Lay-in tile ceilings: use unobtrusive identification locators.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access door installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
 - .1 Tiled surfaces: in accordance with Section 09 30 13 - Ceramic Tiling.
 - .2 Install masonry surfaces: in accordance with Section 04 05 00 - Common Work Results for Masonry.
 - .3 Install gypsum board surfaces: in accordance with Section 09 21 16 - Gypsum Board Assemblies.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Aluminum doors and frames.
- .2 Vision glass and insulated metal glass infill panels.
- .3 Door hardware.
- .4 Perimeter sealant.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Metal Fabrications: Steel fabricated framed openings.
- .2 Section 07 27 13 - Air Barriers: Perimeter air seal between glazing system and adjacent construction.
- .3 Section 07 84 00 - Firestopping: Fire stop at system junction with structure.
- .4 Section 07 92 00 - Joint Sealants: System perimeter sealant and back-up materials.
- .5 Section 08 44 30 - Glazed Aluminum Curtain Wall and SSG Assemblies
- .6 Section 08 51 13 - Aluminum Windows: Operable sash within glazing system.
- .7 Section 08 71 00 - Door Hardware - General: Mortised hardware reinforcement requirements affecting framing members.
- .8 Section 08 80 50 - Glass and Glazing.
- .9 Section 09 91 10 - Painting: Field painting of interior surfaces.

1.3 REFERENCES

- .1 AA (Aluminum Association) DAF 45-2003 - Designation System for Aluminum Finishes.
- .2 AAMA CW-DG-1-96 (R2005) - Aluminum Curtain Wall Design Guide Manual.
- .3 AAMA CWG-1-89 (R2004) - Installation of Aluminum Curtain Walls.
- .4 AAMA CW-10-04 - Care and Handling of Architectural Aluminum from Shop to Site.
- .5 AAMA 501-05 - Methods of Test for Exterior Walls.
- .6 AAMA 501.1-05 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.
- .7 AAMA 611-98 - Voluntary Specifications for Anodized Architectural Aluminum.
- .8 AAMA 2603-02 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .9 AAMA 2605-05 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .10 AAMA RPC-00 - Rain Penetration Control.
- .11 AAMA SFM-1-87 (Reissued 2002) - Aluminum Store Front and Entrance Manual.

- .12 ASTM A36/A36M-08 - Standard Specification for Carbon Structural Steel.
- .13 ASTM A123/A123M-09 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .14 ASTM A653/A653M-10 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .15 ASTM B209M-07 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .16 ASTM B221M-07 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .17 ASTM E283-04 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .18 ASTM E330-02(2010) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .19 ASTM E331-00(2009) - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- .20 ASTM E1105-00 (2008) - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .21 CAN/CGSB 1.40-97 - Anticorrosive Structural Steel Alkyd Primer.
- .22 CAN/CGSB 1.181-99 - Ready-Mixed Organic Zinc-Rich Coating.

1.4 SYSTEM DESCRIPTION

- .1 Aluminum entrances and storefront system includes tubular aluminum sections with supplementary internal support framing, shop fabricated, factory finished, vision glass, insulated metal panel infill glass infill, related flashings, anchorage and attachment devices.
- .2 System Assembly: Site assembled.

1.5 PERFORMANCE REQUIREMENTS

- .1 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as measured in accordance with ASTM E330.
- .2 Deflection: Limit mullion deflection to flexure limit of glass of span; with full recovery of glazing materials.
- .3 System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.
- .4 Air Infiltration: Limit air infiltration through assembly to (0.3 l/s/sq m) 0.06 cfm/min/sq ft of wall area, measured at a reference differential pressure across assembly of (75 Pa) 1.57 psf as measured to ASTM E283.

- .5 Vapour Seal: Limit vapour seal with interior atmospheric pressure of (25 mm) sp, 22 degrees C), 40% RH without seal failure. Maintain continuous air barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- .6 Water Leakage: None, when measured to AAMA 501.1.
- .7 Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 95 degrees C over a 12 hour period without causing detrimental effect to system components and anchorage.
- .8 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 19: Project Meetings.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the Work with installation of vapour retarder firestopping air barrier components or materials.
 - .2 Pre-Installation Meeting: Convene one (1) week before starting work of this section.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware and internal drainage details.
- .3 Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.
- .4 Design Data: Provide framing member structural and physical characteristics.

1.8 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.
- .2 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.9 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work in accordance with AAMA SFM-1.
- .3 Conform to requirements of NBCC code for accessibility.
- .4 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .5 Installer Qualifications: Installer specializing in performing the work of this section with documented experience and approved by the manufacturer. Contractor to submit names and experience of individuals performing the work of this section.

- .6 Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.10 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Handle Products of this section in accordance with AAMA CW-10.
- .3 Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install sealants when ambient temperature is less than 5 degrees C during and 48 hours after installation.

1.12 WARRANTY

- .1 Provide warranty to include coverage for failure to meet specified requirements.

Part 2 Products

2.1 MANUFACTURERS

- .1 Exterior Window Framing Product
 - .1 Alumicor; Product: BF 3400.
 - .1 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Kawneer; Product: 451T.
 - .2 AD Prevest; Product: 40 Series.
 - .2 Substitutions: Refer to Section 01 62 00.

2.2 MATERIALS

- .1 Extruded Aluminum: ASTM B221/B221M.
- .2 Sheet Aluminum: ASTM B209/ASTM B209M.
- .3 Fasteners: Stainless steel.

2.3 GLASS AND GLAZING MATERIALS

- .1 Glass and Glazing Materials: As specified in Section 08 80 50.

2.4 SEALANT MATERIALS

- .1 Sealant and Backing Materials:
 - .1 Perimeter Sealant: Type as specified in Section 07 92 00.
 - .2 Sealant Used Within System (Not Used for Glazing): Type as specified in Section 07 92 00.

2.5 HARDWARE

- .1 Refer to Section 08 71 00 – Door Hardware Common Requirements.
- .2 Hardware supplied and installed by this contractor.

2.6 FABRICATION

- .1 Fabricate components with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- .3 Prepare components to receive anchor devices. Fabricate anchors.
- .4 Arrange fasteners and attachments to conceal from view.
- .5 Reinforce interior horizontal head rail to receive blind track brackets and attachments.
- .6 Prepare components with internal reinforcement for door hardware and door operator hinge hardware.
- .7 Reinforce framing members for imposed loads.

2.7 FINISHES

- .1 Clear Anodic Coating: Class I, AA-M12C22A41.
- .2 Concealed Steel Items:
 - .1 Primed with iron oxide paint.
- .3 Apply two (2) coats of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.
- .4 Shop and Touch-Up Primer for Steel Components: CAN/CGSB-1.40.
- .5 Touch-Up Primer for Galvanized Steel Surfaces: CAN/CGSB-1.181.
- .6 Extent of Finish:
 - .1 Apply factory coating to all surfaces exposed at completed assemblies.
 - .2 Apply finish to surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - .3 Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify dimensions, tolerances, and method of attachment with other work.
- .3 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this Section.

3.2 INSTALLATION

- .1 Install wall system in accordance with AAMA CWG-1.

- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Provide alignment attachments and shims to permanently fasten system to building structure.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- .5 Provide thermal isolation where components penetrate or disrupt building insulation.
- .6 Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- .7 Coordinate attachment and seal of perimeter air barrier materials.
- .8 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- .9 Install flashings and seal to air barrier.
- .10 Set thresholds in bed of mastic and mechanically fastened to substrate.
- .11 Install hardware using manufacture templates. Refer to Section 08 71 00 for installation requirements.
- .12 Install glass and infill panels in accordance with Section 08 80 50, to glazing method required to achieve performance criteria.
- .13 Install perimeter sealant to method required to achieve performance criteria in accordance with Section 07 92 00.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Execution.
- .2 Maximum Variation from Plumb: (1.5 mm/ m) 1/16 in/ yd non-cumulative or (1.5 mm/ 3 m) 1/16 in 10 ft, whichever is less.
- .3 Maximum Misalignment of Two Adjoining Members Abutting in Plane: (0.8 mm) 1/32 in.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Quality Control, Field adjusting.
- .2 Inspection will monitor quality of installation and glazing.
- .3 Third Party Test per Section 01 91 19 Facility Commissioning - Envelope
- .4 Test to AAMA 501.

3.5 ADJUSTING

- .1 Adjust operating hardware for smooth operation.

3.6 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove protective material from pre-finished aluminum surfaces.
- .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

- .4 Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect finished Work from damage.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-[2000], American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-[2003], Bored and Preamsembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-[2001], Exit Devices.
 - .4 ANSI/BHMA A156.4-[2000], Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-[2001], Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6-[2005], Architectural Door Trim.
 - .7 ANSI/BHMA A156.8-[2005], Door Controls - Overhead Stops and Holders.
 - .8 ANSI/BHMA A156.10-[1999], Power Operated Pedestrian Doors.
 - .9 ANSI/BHMA A156.12-[2005], Interconnected Locks and Latches.
 - .10 ANSI/BHMA A156.13-[2002], Mortise Locks and Latches Series 1000.
 - .11 ANSI/BHMA A156.14-[2002], Sliding and Folding Door Hardware.
 - .12 ANSI/BHMA A156.15-[2006], Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .13 ANSI/BHMA A156.16-[2002], Auxiliary Hardware.
 - .14 ANSI/BHMA A156.17-[2004], Self-closing Hinges and Pivots.
 - .15 ANSI/BHMA A156.18-[2006], Materials and Finishes.
 - .16 ANSI/BHMA A156.19-[2002], Power Assist and Low Energy Power - Operated Doors.
 - .17 ANSI/BHMA A156.20-[2006], Strap and Tee Hinges and Hasps.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Tools:
 - .1 Supply 2 sets of wrenches for door closers locksets and fire exit hardware.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping strippable coating.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARDWARE ITEMS

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

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Mortise locks and latches: to ANSI/BHMA A156.13, listed in Hardware Schedule.
- .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1, listed in Hardware Schedule.
 - .2 Self-closing hinges and pivots: to ANSI/BHMA A156.17, listed in Hardware Schedule.
- .3 Exit devices: to ANSI/BHMA A156.3, listed in Hardware Schedule.
- .4 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, listed in Hardware Schedule.
 - .2 Door controls - overhead holders: to ANSI/BHMA A156.8, listed in Hardware Schedule.
 - .3 Closer/holder release devices: to ANSI/BHMA A156.15, listed in Hardware Schedule.
 - .4 Door co-ordinator: concealed for pairs of doors with overlapping astragal.
- .5 Door Operators:
 - .1 Power-operated pedestrian doors: to ANSI/BHMA A156.10, listed in Hardware Schedule.
 - .2 Power assist and low energy power operated doors: to ANSI/BHMA A156.19, listed in Hardware Schedule.
- .6 Auxiliary locks and associated products: to ANSI/BHMA A156.5, listed in Hardware Schedule.
- .7 Architectural door trim: to ANSI/BHMA A156.6, listed in Hardware Schedule.
- .8 Sliding and folding door hardware: to ANSI/BHMA A156.14, as listed in Hardware Schedule.
- .9 Auxiliary hardware: to ANSI/BHMA A156, listed in Hardware Schedule.
- .10 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene weatherseal, surface mounted with drip cap, closed ends, adjustable, clear anodized finish.
- .11 Thresholds: Full width of door opening, extruded aluminum mill finish, serrated surface, with thermal break of rigid PVC, with vinyl door seal insert.
- .12 Weatherstripping:
 - .1 Head and jamb seal:
 - .1 Extruded aluminum frame and hollow closed cell neoprene pile insert, clear anodized finish.
 - .2 Adhesive backed neoprene material.
 - .2 Door bottom seal:
 - .1 Extruded aluminum frame and closed cell neoprene nylon brush sweep, clear anodized finish.
- .13 Astragal: overlapping, extruded aluminum frame with pile insert, finished to match doors.

- .14 Barrier Free Pneumatic Door Operator:
- .1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.
 - .2 Self contained control box/compressor combination for independent operation of two door leaves.
 - .3 Control boxes: complete with electric strike relay.
 - .4 Mount operators on either push or pull sides of doors as required to place them inside rooms.
 - .5 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.
 - .6 Supply switched line voltage to control box. Locate switch adjacent to box.
 - .7 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.
 - .8 Mount control box in location as directed by Departmental Representative.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

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

Part 3 Execution

3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Departmental Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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

3.4 DEMONSTRATION

- .1 Keying System Setup and Cabinet:
 - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
 - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
 - .3 Lock key cabinet and turn over key to Departmental Representative.
- .2 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers locksets and fire exit hardware.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

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

3.6 SCHEDULE

- .1 To follow by Addendum.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Glazing for sections referencing this section for Products and installation.

1.2 RELATED SECTIONS

- .1 Section 07 27 13 - Air Barriers.
- .2 Section 07 92 00 - Joint Sealants: Sealant and back-up material.
- .3 Section 08 11 13 - Standard Metal Doors and Frames.
- .4 Section 08 14 16 - Flush Wood Doors: Glazed doors.
- .5 Section 08 41 13 - Aluminum Frame Entrances.

1.3 REFERENCES

- .1 ANSI Z97.1-2009 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- .2 ASTM C542-05 - Standard Specification for Lock-Strip Gaskets.
- .3 ASTM C864-05 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- .4 ASTM C920-11 - Standard Specification for Elastomeric Joint Sealants.
- .5 ASTM C1036-06 - Standard Specification for Flat Glass.
- .6 ASTM C1048-04 - Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
- .7 ASTM C1172-09e1 - Standard Specification for Laminated Architectural Flat Glass.
- .8 ASTM C1193-09 - Standard Guide for Use of Joint Sealants.
- .9 ASTM C1503-08 - Standard Specification for Silvered Flat Glass Mirror.
- .10 ASTM D412-06ae2 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
- .11 ASTM D1149-07 - Standard Test Methods for Rubber Deterioration-Cracking in an Ozone Controlled Environment.
- .12 ASTM D2240-05(2010) - Standard Test Method for Rubber Property—Durometer Hardness.
- .13 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .14 ASTM E283-04 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .15 ASTM E330-02(2010) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .16 CAN/CGSB 12.1-M90 - Tempered or Laminated Safety Glass.

- .17 CAN/CGSB 12.2-M91 - Flat, Clear Sheet Glass.
- .18 CAN/CGSB 12.3-M91 - Flat, Clear Float Glass.
- .19 CAN/CGSB 12.4-M91 - Heat Absorbing Glass.
- .20 CAN/CGSB 12.6-M91 - Transparent (One-Way) Mirrors.
- .21 CAN/CGSB 12.8-97 - Insulating Glass Units.
- .22 CAN/CGSB 12.9-M91 - Spandrel Glass.
- .23 CAN/CGSB 12.10-M76 - Glass, Light and Heat Reflecting.
- .24 CAN/CGSB 12.11-M90 - Wired Safety Glass.
- .25 CAN/CGSB 12.12-M90 - Plastic Safety Glazing Sheets.
- .26 CAN/CGSB 12.13-M91 - Patterned Glass.
- .27 CAN/CGSB 12.20-M89 - Structural Design of Glass for Buildings.
- .28 CGSB 19-GP-5M-84 - Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .29 GANA (Glass Association of North America).
 - .1 GANA Glazing Manual (50th Anniversary Edition).
 - .2 GANA Glazing Manual (2008).
 - .3 GANA Laminated Glazing Reference Manual (2009).
- .30 IGMAC (Insulating Glass Manufacturers Association of Canada) - IGMAC Certification Program for the CGSB 12.8 standard.
- .31 IGMA (Insulating Glass Manufacturers Alliance).
- .32 LSGA (Laminators Safety Glass Association) Laminated Glass Design Guide 2000.

1.4 PERFORMANCE REQUIREMENTS

- .1 Provide glass and glazing materials for continuity of building enclosure vapour retarder and air barrier:
 - .1 In conjunction with materials described in Section 07 92 00 and 07 27 13.
 - .2 To utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapour retarder seal.
 - .3 To maintain a continuous air barrier and vapour retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- .2 Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as measured to ASTM E283 .
- .3 Limit glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Preinstallation Meetings: Convene one (1) week before starting work of this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.

- .2 Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- .3 Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colours.

1.7 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work in accordance with GANA Glazing Manual and IGMAC for glazing installation methods.
- .3 Installer Qualifications: Installer specializing in performing the work of this section with documented experience and approved by the manufacturer. Contractor to submit names and experience of individuals performing the work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install glazing when ambient temperature is less than 5 degrees C.
- .2 Maintain minimum ambient temperature before, during and twenty-four (24) hours after installation of glazing compounds.

1.10 WARRANTY

- .1 Provide warranty to include coverage for failure to meet specified requirements.
- .2 Section 01 78 10: Warranties.
- .3 Provide a extended warranty to include coverage for sealed glass units from seal failure, inter-pane dusting or misting, and replacement of same.
- .4 Provide a five (5) extended warranty to include coverage for delamination of laminated glass and replacement of same.

Part 2 Products

2.1 FLAT GLASS MATERIALS

- .1 Flat Glass (Type FG-A): CAN/CGSB-12.3 M91, Clear, 3mm (1/4 in) thick
- .2 Flat Glass (Type FG-B): CAN/CGSB-12.3 M91, Clear, 6mm (1/4 in) thick.
- .3 Heat Strengthened (Type FG-C): CAN/CGSB-12.1, Clear. Heat Strengthened; 6mm (1/4 in) thick.
- .4 Heat Strengthened (Type FG-D): CAN/CGSB-12.1, Clear. Heat Strengthened; 8mm (5/16 in) thick
- .5 Tempered Glass (Type FG-E): CAN/CGSB-12.1, Clear, Tempered; 3mm (1/8 in) thick.
- .6 Tempered Glass (Type FG-F): CAN/CGSB-12.1, Clear, Tempered; 4mm (3/16 in) thick.
- .7 Tempered Glass (Type FG-G): CAN/CGSB-12.1, Clear, Tempered; 6mm (1/4 in) thick.
- .8 Tempered Glass (Type FG-H): CAN/CGSB-12.1, Clear, Tempered; 8mm (5/16 in) thick.

- .9 Tempered Wired Glass (Type FG-J): CAN/CGSB 12.11, polished both sides (transparent), woven stainless steel wire mesh style rectangular of 13 mm grid size; 6 mm (1/4 in) thick.

2.2 SEALED INSULATED GLASS UNITS

- .1 Type GL-1: Double Glazed Insulating Glass Unit: CAN/CGSB-12.8, double pane; outer pane of Type FG-C/Type FG-G glass, inner pane of Type FG-C/Type FG-G glass; Sun-Guard Silver 20 on No. 2 surface; low-E soft coat on No. 3 surface; 13 mm interpane space filled with argon gas; with closed cell polymer foam warm edge, seal glass with elastomer; total unit thickness of 25 mm. Panes (lites) to be either Heat Strengthened or Tempered as noted on glazing elevation drawings.

2.3 GLAZING COMPOUNDS

- .1 Sealant: in accordance with Section 07 92 00 Joint Sealants.

2.4 GLAZING ACCESSORIES

- .1 Lock Strip Gaskets: ASTM C542, ozone-resistant neoprene compound, with lock-strip (zipper) component that friction-fits into position to retain glass pane/unit, H-shape, tensile strength of (14 MPa) 2000 psi tested to ASTM D412, Durometer hardness of 75 tested to ASTM D2240, sized to accommodate glass thickness.
- .2 Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10-15 Shore A durometer hardness tested to ASTM D2240; coiled on release paper; (13 mm) 1/2 inch size; black colour.
- .3 Glazing spline: ASTM C864, Option I, Resilient H-shaped extruded shape to suit glazing channel retaining slot; black colour.
- .4 Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units destined for smoke control.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.
- .4 Install sealant in accordance with manufacturer's written instructions.

3.3 GLAZING METHODS

- .1 Verify that selected sealants and glazing tapes are compatible.

- .2 Perform glazing as required by frame manufacturer to achieve specified performance criteria.
- .3 Completed exterior glazed assemblies to provide full perimeter air and vapour seal to the glazed frames and be pressure equalized.

3.4 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Remove glazing materials from finish surfaces.
- .3 Remove labels after Work is complete.
- .4 Clean glass and adjacent surfaces.

3.5 PROTECTION OF FINISHED WORK

- .1 After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-[03(R2009)], Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 475-[02(2015)], Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C 514-[04(2014)], Standard Specification for Nails for the Application of Gypsum Board.
 - .3 ASTM C 557-[03(2009)e1], Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - .4 ASTM C 840-[16], Standard Specification for Application and Finishing of Gypsum Board.
 - .5 ASTM C 954-[15], Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (mm) to 0.112 in. (mm) in Thickness.
 - .6 ASTM C 1002-[14], Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .7 ASTM C 1047-[14a], Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .8 ASTM C 1177/C 1177M-[13], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .9 ASTM C 1178/C 1178M-[13], Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
 - .10 ASTM C 1280-[13a], Standard Specification for Application of Gypsum Sheathing.
 - .11 ASTM C1396/C1396M-[14a], Standard Specification for Gypsum board.
- .3 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish-GA-214-2015.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-[M86(R1988)], Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CAN/CGSB-71.25-[M88], Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .5 Green Seal Environmental Standards (GS)
 - .1 GS-11-[2008, 2nd Edition], Paints and Coatings.
- .6 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address and applicable standard designation.
- .3 Exercise care in unloading gypsum board materials shipment to prevent damage.
- .4 Storage and Handling Requirements in accordance with ASTM C 840-16:
 - .1 Store gypsum board assembly materials level flat indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
 - .3 Protect gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
 - .4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.
 - .5 Protect from weather, elements and damage from construction operations.
 - .6 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .7 Protect prefinished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
 - .8 Replace defective or damaged materials with new.

1.4 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .2 Installer Qualifications: Installer specializing in performing the work of this section with minimum documented experience and approved by the manufacturer.
- .3 Contractor to submit names and work experience of approved installers to preform the work of this section.
- .4 Handling Gypsum Board: Comply with GA-801.

1.5 AMBIENT CONDITIONS

- .1 Maintain temperature 10 °C minimum, 21 °C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, clean, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

- .1 Standard board: to ASTM C1396/C1396M-14 regular, 15.9 mm thick and Type X, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges squared.
- .2 Gypsum sheathing board: to ASTM C1396/C1396M-14, regular, 12.7 mm thick and Type X, 12.7 mm thick, 1200 mm wide x maximum practical length.
- .3 Backing board and core board: to ASTM C1396/C1396M-14 regular, 12.7 mm thick, squared edges.
- .4 Interior Water-resistant board: to ASTM C1396/C1396M-14 regular, 12.7 mm thick and Type X, 12.7 mm thick, 1200 mm wide x maximum practical length.
- .5 Exterior Glass mat water-resistant gypsum backing board: to ASTM C 1178/C 1178M-13, 12.7 mm thick, 1200 mm wide x maximum practical length.
- .6 Impact Resistant Glass mat gypsum substrate sheathing: to ASTM C 1177/C 1177M-13, 15.9 mm thick, 1200 mm wide x maximum practical length.

2.2 ACCESSORIES

- .1 Gypsum Board Fasteners: ASTM C1002, Type S12.
- .2 Metal furring runners, hangers, tie wires, inserts, and anchors: to CSA A82.30 galvanized.
- .3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .4 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .5 Steel drill screws: to ASTM C 1002-14.
- .6 Stud adhesive: to CAN/CGSB-71.25.
- .7 Laminating compound: as recommended by manufacturer, asbestos-free.

- .8 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, metal, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.
 - .1 GA-216; Trimtex: 093 Expansion Bead
- .9 Shadow mould: 35 mm high, snap-on trim, of 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.
 - .1 GA-216; Trimtex: L-bead, Reveal/shadow bead, F Bead as noted.
- .10 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .11 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .12 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.
- .13 Joint compound: to ASTM C 475, asbestos-free.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assembly installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C 840-16 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C 1280-13a.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C 840-16 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

- .8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes to ASTM C 840-16, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with [25] mm drywall screw.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners, laminating adhesive for second layer. Maximum spacing of screws 300mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840-16.
 - .2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.
 - .2 Double-Layer Application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
 - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
 - .3 Apply base layers at right angles to supports unless otherwise indicated.
 - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
- .3 Exterior Soffits and Ceilings: install exterior gypsum board perpendicular to supports; stagger end joints over supports. Install with 6 mm gap where boards abut other work.
- .4 Apply water-resistant gypsum board where wall tiles to be applied and adjacent to slop sinks. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
- .5 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building

components. Seal full perimeter of cut-outs around electrical boxes, ducts, openings, in partitions where perimeter sealed with acoustic sealant.

- .6 Apply Abuse resistant gypsum board for bottom 1200mm of ever wall indicated to receive Gypsum Wall Board except where water-resistant gypsum board is required.
- .7 Apply board using laminating adhesive on base layer of gypsum board.
- .8 Studless Solid Gypsum Wallboard Partitions: UL U529.
- .9 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .10 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .11 Install gypsum board with face side out.
- .12 Do not install damaged or damp boards.
- .13 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre or use contact adhesive for full length, where applicable.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install shadow mould at gypsum board/ceiling juncture [as indicated]. Minimize joints; use corner pieces and splicers.
- .6 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .7 Provide continuous polyethylene dust barrier behind and across control joints.
- .8 Locate control joints at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.
- .9 Install control joints straight and true.

- .10 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.
- .11 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.
- .12 Install expansion joint straight and true.
- .13 Install cornice cap where gypsum board partitions do not extend to ceiling.
- .14 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.
- .15 Splice corners and intersections together and secure to each member with 3 screws.
- .16 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .17 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .18 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
 - .1 Levels of finish:
 - .1 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable. (For use where water resistant gypsum backing board is used as a substrate for tile.)
 - .2 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges. (For typical gypsum wall board assemblies)
 - .3 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges. (For continuous gypsum board walls and partitions exposed to natural light that are more than 4000 mm in height or 7,000 mm in width).
- .19 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .20 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.
- .21 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

- .22 Completed installation smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .23 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .24 Mix joint compound slightly thinner than for joint taping.
- .25 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .26 Allow skim coat to dry completely.
- .27 Remove ridges by light sanding or wiping with damp cloth.

3.5 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.

3.6 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 05 50 00 – Metal Fabrications: Metal fabrications attached to stud framing.
- .2 Section 07 21 16 – Blanket Insulation: Insulation between framing members
- .3 Section 07 27 13 – Air Barriers.
- .4 .
- .5 Section 07 62 00 – Metal Flashing and Trim: Head and sill flashings.
- .6 Section 09 21 16 – Gypsum Board Assemblies: Gypsum board on metal studs for partitioning.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 645-14e1, Standard Specification for Nonstructural Steel Framing Members.
 - .2 ASTM A 653/A 653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
 - .3 ASTM C 754-15, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Underwriter's Laboratories (UL) Environmental Standards
 - .1 UL-2768-2011, Architectural Surface Coatings.
 - .2 , Surface Coatings – Recycled Water-Borne. UL-2760-2011
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual – [current edition].
 - .1 MPI #26, Primer, Galvanized Metal, Cementitious.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2copies of WHMIS SDS in accordance with Section– 01 35 45 – Environmental Procedures

1.4 – QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .2 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum documented experience and approved by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00 – Material and Equipment and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal framing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C 645, 63, 92, 152, 203 mm stud size, roll formed from 0.53 and 0.91 mm thickness hot dipped zinc-coated (galvanized) steel sheet in accordance with ASTM A 653, Z180, for screw attachment of gypsum board.
 - .1 Knock-out service holes at 460 mm centres.
- .2 Floor and ceiling tracks: to ASTM C 645, in widths to suit stud sizes, and as follows:
 - .1 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm on centre along length of runner; tested and certified for use in fire rated wall construction.
 - .2 Double Runner Deflection Track: Outside runner using 75 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.
 - .3 Deep Leg Deflection Track: Top runner having 75 mm down standing legs; maintaining 13 mm minimum deflection space.
 - .4 Base Runner: Bottom track with 33 mm upstanding legs.

- .3 Furring Channels: Commercial steel sheet in accordance with ASTM A 653, Z180, hot dipped zinc-coated (galvanized), as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C 645, 0.75 mm thickness x 22 mm deep.
 - .2 Resilient Furring Channels: 0.46 mm thickness x 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .4 Curving Tracks: Commercial steel sheet with ASTM A 653, Z180, hot dipped zinc-coated (galvanized), complete with flexible sliding straps to allow for curvature indicated on drawings; width to suit framing, and as follows:
 - .1 Width: 65 mm or 92 mm.
 - .2 Minimum base metal thickness: 0.75 mm.
- .5 Metal channel stiffener: 38 x 13 mm size, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .6 Furring and Bracing Members: Of same material as studs; thickness to suit purpose.
- .7 Fasteners: self drilling, self tapping screws.
- .8 Sheet Metal Backing: 0.91 mm thick (20 gauge), galvanized steel for reinforcement of opening.
- .9 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .10 Insulating strip: rubberized, moisture resistant 3 mm thick [cork] [foam] strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

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 non-structural metal framing application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

- .1 Erect partitions in accordance with framing requirements of ASTM C 754.
- .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

- .4 Place studs vertically a maximum of 600 mm on centre, unless noted otherwise, and not more than 50 mm from abutting walls, and at each side of openings and corners.
 - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .5 Erect metal studding to tolerance of 1:1000.
- .6 Attach studs to bottom track using pop rivets.
- .7 Co-ordinate simultaneous erection of studs with installation of service lines. Align web openings when erecting studs.
- .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.
 - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .10 Install heavy gauge single jamb studs at openings.
- .11 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.
 - .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .12 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .13 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .14 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .15 Extend partitions to ceiling height except where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
 - .1 Use 50 mm leg ceiling tracks. Use double track slip joint as drawn or indicated 09 22 16- Gypsum Board Assemblies.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .18 Install two continuous beads of acoustical sealant insulating strip under studs and tracks around perimeter of sound control partitions.

3.3 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.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 Cast-in-Place Concrete
- .2 Section 04 22 00 Concrete Unit Masonry
- .3 Section 09 21 16 Gypsum Wall Board Assemblies

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
 - .1 ANSI A108.1-99, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).
 - .2 CTI A118.3-92, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).
 - .3 CTI A118.4-92, Specification for Latex Cement Mortar (included in ANSI A108.1).
 - .4 CTI A118.5-92, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1).
 - .5 CTI A118.6-92, Specification for Ceramic Tile Grouts (included in ANSI A108.1).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 144-04, Specification for Aggregate for Masonry Mortar.
 - .2 ASTM C 207-06, Specification for Hydrated Lime for Masonry Purposes.
 - .3 ASTM C 847-06, Specification for Metal Lath.
 - .4 ASTM C 979-05, Specification for Pigments for Integrally Coloured Concrete.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CGSB 71-GP-22M-78(AMEND.), Adhesive, Organic, for Installation of Ceramic Wall Tile.
 - .3 CAN/CGSB-75.1-M88, Tile, Ceramic.
 - .4 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .4 CSA Group (CSA)
 - .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
 - .2 CAN/CSA-A3000-03(R2006), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .5 Terrazzo Tile and Marble Association of Canada (TTMAC)
 - .1 Tile Specification Guide 09 30 00 2006/2007, Tile Installation Manual.
 - .2 Tile Maintenance Guide 2000.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Include manufacturer's information on:
 - .1 Ceramic tile, marked to show each type, size, and shape required.
 - .2 Chemical resistant mortar and grout (Epoxy and Furan).
 - .3 Cementitious backer unit.
 - .4 Dry-set cement mortar and grout.
 - .5 Divider strip.
 - .6 Elastomeric membrane and bond coat.
 - .7 Reinforcing tape.
 - .8 Levelling compound.
 - .9 Latex cement mortar and grout.
 - .10 Commercial cement grout.
 - .11 Organic adhesive.
 - .12 Slip resistant tile.
 - .13 Waterproofing isolation membrane.
 - .14 Fasteners.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Base tile: submit duplicate, Full-tile sample panels of each colour, texture, size, and pattern of tile.
 - .2 Floor tile: submit duplicate, Full-tile mm sample panels of each colour, texture, size, and pattern of tile.
 - .3 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance Submittals:
- .2 Manufacturer's Instructions: manufacturer's installation instructions.
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
- .2 Deliver, store and handle materials in accordance with Section 01 60 00 – Material and Equipment.

1.6 AMBIENT CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation.
- .2 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

- .3 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

1.7 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
 - .3 Maintenance material same production run as installed material.

Part 2 PRODUCTS

2.1 FLOOR TILE

- .1 FT1: Full body Porcelain tile to CAN/CGSB-75.1, Natural Finish 10mm Thickness, 24" x 24". Must meet minimum requirements:
 - .1 Water Absorption: $E \leq 0.5\%$ conforming to UNI EN ISO 10545-3
 - .2 Breaking Strength: 35N/mm^2 conforming to UNI EN ISO 10545-4
 - .3 Stain resistance: Class 5 conforming to UNI EN ISO 10545-14
 - .4 Resistance to Acid: GLA conforming to UNI EN ISO 10545-13
 - .5 Dynamic Coefficient of Friction (DCOF) ≥ 0.42 conforming to BOT 3000
 - .6 Standard of Acceptance: Elegant Flooring Galaxy Series Porcelain, colour to be selected by consultant from manufacturer's full colour range.
- .2 FT2: Full body Porcelain tile to CAN/CGSB-75.1, Natural Finish 10mm Thickness, 12" x 24". Must meet minimum requirements:
 - .1 Water Absorption: $E \leq 0.5\%$ conforming to UNI EN ISO 10545-3
 - .2 Breaking Strength: 35N/mm^2 conforming to UNI EN ISO 10545-4
 - .3 Stain resistance: Class 5 conforming to UNI EN ISO 10545-14
 - .4 Resistance to Acid: GLA conforming to UNI EN ISO 10545-13
 - .5 Dynamic Coefficient of Friction (DCOF) ≥ 0.42 conforming to BOT 3000
 - .6 Standard of Acceptance: Elegant Flooring Galaxy Series Porcelain, colour to be selected by consultant from manufacturer's full colour range.
- .3 FT3: Full body Porcelain tile to CAN/CGSB-75.1, Natural Finish 10mm Thickness, 0.8"x 2.75" mosaic tile. Must meet minimum requirements:
 - .1 Water Absorption: $E \leq 0.5\%$ conforming to UNI EN ISO 10545-3
 - .2 Breaking Strength: 35N/mm^2 conforming to UNI EN ISO 10545-4
 - .3 Stain resistance: Class 5 conforming to UNI EN ISO 10545-14
 - .4 Resistance to Acid: GLA conforming to UNI EN ISO 10545-13
 - .5 Dynamic Coefficient of Friction (DCOF) ≥ 0.42 conforming to BOT 3000

- .6 Standard of Acceptance: Elegant Flooring Galaxy Series Porcelain, colour to be selected by consultant from manufacturer's full colour range.

2.2 WALL TILE

- .1 Ceramic tile: to CAN/CGSB-75.1, 4" x 16" glazed tile, colour as selected by Consultant
 - .1 Standard of Acceptance: Elegant Flooring Roca Ceramic Tile.
- .2 Ceramic tile: to CAN/CGSB-75.1, 6" x 6.5" triangle glazed tile, with three-dimensional surface. Colour white.
 - .1 Standard of Acceptance: Elegant Flooring Evoke Series. 50% Triangle Level, 50% Triangle Cascade.

2.3 BASE TILE

- .1 Base: Aluminum Base (AB): Schluter DesignBase- SL
 - .1 Base to include 90° inside and outside corners, connectors, end caps and sealing lip.
 - .2 Colour: Matte White.

2.4 STAIR TREADS

- .1 Stair Treads: Aluminum Nosing: Schluter TREP- G. Coordinate with depth of Porcelain tile Type FT2.

2.5 GROUT AND ADHESIVE MATERIALS

- .1 Colouring Pigments:
 - .1 Pure mineral pigments, lime-proof and nonfading, complying with ASTM C 979.
 - .2 Colouring pigments to be added to grout by manufacturer.
 - .3 Job coloured grout are not acceptable.
 - .4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.
- .2 Commercial Cement Grout: to CTI A118.6.
- .3 Dry-Set Grout: to CTI A118.6.
- .4 Latex Cement Grout: to ANSI A108.1, fast curing, high early strength, polymer-modified, stain resistant, sanded mix for floors, unsanded mix for walls and floors with polished tiles commercial tile grout.
- .5 Manufacturers:
 - .1 Kiesel; Product: tile setting materials.
 - .2 Acceptable alternate manufacturers:
 - .1 TEC; Product: tile setting materials.

- .2 Mapei; Product: tile setting materials.
- .3 Adhesive Materials: ANSI A118.4, Latex Modified, Portland cement, sand, latex additive and water.
 - .1 Thinset mortar - Walls: Kiesel Servorlight
 - .2 Thinset mortar - Floors: Kiesel Servoflex-Trio - SuperTec
- .4 Grout: ANSI A118.6, Alumina cement tile grout, colour as selected from standard range.
 - .1 .1 Kiesel, Servoperl Royal
- .5 Primer: Solvent free, acrylic base primer.
 - .1 Keisel Okatmos UG-30
- .6 Patching/Skimming/Mortar Bed Compound: Cement based, polymer modified.
 - .1 Keisel Servocret RS

2.6 ACCESSORIES

- .1 Waterproof Membrane: ANSI A118.10, Sheet Membrane:
 - .1 Kerdi Membrane by Schluter Systems, No substitutions. Provide Sealing strips, Pre-moulded corners, pre-cut penetration pieces and all accessories recommended by Manufacturer.
 - .2 Bonding adhesive between Kerdi Components; Schluter Kerdi-Fix.
- .2 Prefabricated Foam Shower Pans:
 - .1 Kerdi Shower-ST by Schluter systems 36"x36". No substitutions.
- .3 Uncoupling Membrane: Polyethylene mat with shaped recesses and an anchoring fleece laminated to underside:
 - .1 Schluter; Product: Ditra
- .4 Tile Trims: Stainless Steel, sized to suit tile, provide end caps, inside and outside corners, manufactured by Schluter:
 - .1 Schiene Edge Profile.
- .5 Transition Strips: purpose made metal extrusion; stainless steel type.
- .6 Reducer Strips: purpose made metal extrusion; stainless steel type; maximum slope of 1:2.
- .7 Prefabricated Movement Joints: purpose made, having a Shore A Hardness not less than 60 and elasticity of plus or minus 40 percent when used in accordance to TTMAC Detail 301EJ.
- .8 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .9 Floor sealer and protective coating: to CAN/CGSB-25.20, Type 2 to tile and grout manufacturers recommendations.

2.7 MIXES

- .1 Cement:

- .1 Scratch coat: one (1) part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, four (4) parts sand, one (1) part water, [and latex additive where required]. Adjust water volume depending on water content of sand.
- .2 Slurry bond coat: cement and water mixed to creamy paste. Latex additive may be included.
- .3 Mortar bed for floors: one (1) part cement, four (4) parts sand, one (1) part water. Adjust water volume depending on water content of sand. Latex additive may be included.
- .4 Mortar bed for walls and ceilings: one (1) part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, four (4) parts sand and one (1) part water. Adjust water volume depending on water content of sand. [Latex additive may be included].
- .5 Levelling coat: one (1) part cement, four (4) parts sand, minimum 1/10 part latex additive, one (1) part water including latex additive.
- .6 Bond or setting coat: one (1) part cement, 1/3 part hydrated lime, one (1) part water.
- .7 Measure mortar ingredients by volume.
- .2 Dry set mortar: mix to manufacturer's instructions.
- .3 Organic adhesive: pre-mixed.
- .4 Mix bond and levelling coats, and grout to manufacturer's instructions.
- .5 Adjust water volumes to suit water content of sand.

2.8 PATCHING AND LEVELLING COMPOUND

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:
 - .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
 - .4 Density - 1.9.
- .3 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in 48 hours after application.

2.9 CLEANING COMPOUNDS

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 WORKMANSHIP

- .1 Do tile work in accordance with TTMAC Tile Installation Manual 2006/2007, "Ceramic Tile", except where specified otherwise.
- .2 Apply tile or backing coats to clean and sound surfaces.
- .3 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .4 Maximum surface tolerance 1:800.
- .5 Make joints between tile uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .6 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .8 Make internal angles square, external angles square with stainless steel exterior edge trim.
- .9 Install divider or transition strips at junction of tile flooring and dissimilar materials.
- .10 Allow minimum 24 hours after installation of tiles, before grouting.
- .11 Clean installed tile surfaces after installation and grouting cured.
- .12 Make control joints where indicated. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07 92 00 - Joint Sealants. Keep building expansion joints free of mortar and grout.

3.3 FLOOR SEALER AND PROTECTIVE COATING

- .1 Apply in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 21 16 - Blanket Insulation.
- .2 Section 08 31 00 - Access Doors and Frames: Access panels.
- .3 Section 09 21 16 - Gypsum Board Assemblies: Acoustic partition system.
- .4 Division 21 00 00 - Fire Suppression: Sprinkler heads in ceiling system.
- .5 Division 23 00 00 HVAC Air Distribution: Air inlets and outlets to be coordinated with ceiling
Division 26 00 00 – Electrical: Light fixtures in ceiling system.
- .6 Division 27 11 19 - Terminals and Connectors for Building Communication Conductors:
Speakers in ceiling system.
- .7 Division 28 00 00 – Electronic Safety and Security: Fire alarm components in ceiling system.
- .8 Section 26 50 00 – Lighting: light equipment
- .9 Section 26 53 00 – Exit Signs

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 423-09, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM E 580/E 580M-14 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 - .3 ASTM C 635/C 635M-13a, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .4 ASTM C 636/C 636M-08, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .5 ASTM E 1264-14, Standard Classification for Acoustical Ceiling Products.
 - .6 ASTM E 1414/E 1414M 11ae1 Standard Test Method for Sound Attenuation between Rooms Sharing a Common Ceiling Plenum.
 - .7 ASTM E 1477-98a(2013), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
 - .8 ASTM F 1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction and Amendment No. 1 1988.

- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-[2003], Surface Burning Characteristics of Building Materials and Assemblies.

1.3 COORDINATION

- .1 Do not begin erection of ceiling suspension system until work above ceiling has been inspected by Consultant.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension, acoustic panels, acoustic tiles, and system accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit reflected ceiling plans for special grid patterns as indicated.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines change in level details, access door dimensions, and locations and acoustical unit support at ceiling fixture lateral bracing and accessories.
- .4 Delegated Design Submittals:
 - .1 Submit delegated design shop drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Indicate components and installation methods to conform to specified seismic design and construction requirements of Contract Documents and in general accordance with ASTM E 580/E 580M.
 - .3 Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures and services within the ceiling, seismic isolation joints and partition bracing.
- .5 Samples:
 - .1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.
 - .2 Submit duplicate samples of each component proposed for use in each type of ceiling suspension system.
 - .3 Submit duplicate full size 150 mm x 100 mm samples of each type of acoustical unit.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Submit operation and maintenance data for acoustical suspension for incorporation into manual.
- .3 Submit final certificate from design professional responsible for delegated detail design of ceiling indicating conformity with accepted shop drawings.

1.6 MAINTENANCE MATERIALS

- .1 Provide extra acoustical units in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type of acoustical panel, suspension system and trim required for project, minimum 1 complete factory-sealed package of each.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Deliver extra materials for each type of acoustical unit in original unopened packages clearly identified, including colour and texture.
- .5 Deliver to Consultant, upon completion of the work of this section.

1.7 CERTIFICATIONS

- .1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Include certification of sustainable requirements.

1.8 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up 10 m² minimum of each type acoustical ceiling assembly including one inside corner and one outside corner . Ceiling system mock-up to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation, seismic reinforcing.
- .3 Construct mock-up where directed.
- .4 Allow 24 hours for inspection of mock-up by Consultant before proceeding with ceiling work.
- .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00 – Material and Equipment and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials flat, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect acoustical ceiling panels suspension grid components from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Store extra materials required for maintenance, where directed by Consultant.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20- 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Design Requirements:
 - .1 Heavy duty system to ASTM C 635/ASTM C635M.
 - .2 Maximum deflection: 1/360th of span to ASTM C 635/ASTM C635M deflection test.
- .2 Seismic design requirements:
 - .1 Design acoustical ceiling installation to resist effects of earthquake motions under seismic design conditions specified in Contract Documents. Provide components as necessary to implement design.

2.2 ACOUSTICAL CEILING SUSPENSION

- .1 Acoustical Ceiling Suspension system ASC-1: non- fire rated, made up as follows:
 - .1 Two (2) directional exposed tee bar grid for Acoustic Panels type ACT-1 and ACT-2.
 - .2 Size 15/16"
 - .3 Trims: edge Trims and wall angles as required
 - .4 Wire: As recommended by manufacturer
 - .5 Standard of Acceptance CGC Donn DX
 - .1 Alternate manufacturer: Armstrong: submit equivalent product for approval by consultant.
- .2 Acoustical Ceiling Suspension system ASC-2: non- fire rated, made up as follows:

- .1 Two (2) directional exposed tee bar grid for Acoustic Panel type ACT-3, complete with edge trim for floating ceilings.
- .2 Size 14.2 mm
- .3 Trims: edge Trims and wall angles as required
- .4 Wire: As recommended by manufacturer
- .3 Basic materials for suspension system: commercial quality cold rolled steel zinc coated.
- .4 Exposed tee bar grid components: shop painted satin sheen white. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .5 Hanger wire: galvanized soft annealed steel wire:
 - .1 3.6 mm diameter for access tile ceilings.
- .6 Hanger inserts: purpose made.
- .7 Accessories: splices, clips, wire ties, retainers and wall moulding [flush] [reveal], to complement suspension system components, as recommended by system manufacturer.
- .8 Seismic components and accessories: in accordance with accepted shop drawings.

2.3 ACOUSTICAL CEILING PANELS

- .1 Acoustical Panel ACT- 1 to ASTM E 1264 and as follows.
 - .1 Type: High NRC acoustic panel, Fine texture.
 - .2 Fire Classification: Class A.
 - .1 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
 - .2 Smoke developed 50 or less in accordance with CAN/ULC-S102.
 - .3 Noise Reduction Coefficient (NRC) designation of 0.75.
 - .4 Ceiling Attenuation Class (CAC) rating 35, in accordance with ASTM E 1414.
 - .5 Edge type square.
 - .6 Size 610 x 610 x 19 mm thick.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INTERFACE WITH OTHER WORK

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.3 SUSPENSION SYSTEM INSTALLATION

- .1 Comply with manufacturer's written installation instructions and recommendations, including product technical bulletins, product carton installation instructions, and data sheets.
- .2 Install suspension system in accordance with accepted shop drawings, and ASTM C 636/C 636M except where specified otherwise.
- .3 Lay out system according to reflected ceiling plan.
- .4 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .5 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .7 Ensure suspension system is coordinated with location of related components. Provide carrying channels as necessary to bridge at unavoidable interference between suspension system and other work above ceiling.
- .8 Install wall moulding to provide correct ceiling height.
- .9 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers grilles and speakers.
- .10 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .11 Interlock cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Install access splines to provide 25% ceiling access.
- .14 Expansion joints:
 - .1 Erect two main runners parallel, 25 mm apart, on building expansion joint line. Lay in strip of acoustic tile/board, , 25% narrower than space between 2 'T' bars.
 - .2 Supply and install "Z" shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25 mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.
- .15 Install perimeter trim at floating installations securely anchored to suspension system, in accurate alignment with adjacent assemblies. Install curved trim members in smooth curves to radius indicated.

3.4 ACOUSTICAL CEILING PANEL INSTALLATION

- .1 Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.
- .2 Install fibrous acoustical media and spacers over entire area above suspended metal panels.
- .3 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

3.5 SITE QUALITY CONTROL

- .1 Arrange for periodic site visits by design professional responsible for delegated ceiling design work to review installed work for conformity to design.
- .2 Arrange for periodic site visits by manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.
- .3 Submit written site reports by designer to Consultant within 3 days of visit.

3.6 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.
 - .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 Cast-in-Place Concrete
- .2 Section 04 22 00 Concrete Unit Masonry
- .3 Section 09 21 16 Gypsum Wall Board Assemblies

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
 - .2 ASTM D2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as measured by the James Machine.
 - .3 ASTM D2240: Standard Test Method for Rubber Property (Durometer Hardness).
 - .4 ASTM D3389: Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader).
 - .5 ASTM E648: Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - .6 ASTM E662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - .7 ASTM E1643: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - .8 ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - .9 ASTM F386: Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces.
 - .10 ASTM F410: Standard Test Method for Wear Layer Thickness of Resilient Floor Coverings by Optical Measurement.
 - .11 ASTM F710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - .12 ASTM F925: Standard Test Method for Resistance to Chemicals of Resilient Flooring.
 - .13 ASTM F970: Standard Test Method for Static Load Limit.
 - .14 ASTM F1514: Standard Test method for Measuring Heat Stability of Resilient Flooring by Color Change.
 - .15 ASTM F1515: Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change.
 - .16 ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - .17 ASTM F2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

- .18 ASTM F2199: Standard Test Method for Determining Dimensional Stability of Resilient Floor Tile after Exposure to Heat.
- .2 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-13, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide 10 m² of each colour, pattern and type flooring material required for project for maintenance use.
 - .3 Extra materials one piece and from same production run as installed materials.
 - .4 Identify each roll of sheet flooring and each container of adhesive.
 - .5 Deliver to Owner, upon completion of the work of this section.
 - .6 Store where directed by Owner.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:

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

Part 2 Products

2.1 MATERIALS

- .1 Linoleum sheet flooring: composed of natural ingredients which are mixed and calendered onto a jute backing:
 - .1 Pattern: marbled.
 - .2 Thickness: 3.2 mm.
 - .3 Colour: selected from full range by Departmental Representative.
- .2 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
 - .1 Type: rubber.
 - .2 Style: straight and cove.
 - .3 Thickness: 3.17 mm.
 - .4 Height: 63.5 mm.
 - .5 Lengths: cut lengths minimum 2400 mm.
 - .6 Colour: selected from full range by Departmental Representative.
- .3 Resilient stair nosing: square nose, 5 mm thick, 30 mm vertical face, 40 mm horizontal face ribbed, rubber, colour selected by Departmental Representative.
- .4 Resilient stair tread: rubber, 30 mm vertical face, square nose, full tread deep, 5mm thick, ribbed surface solid pattern, full range of colour selected by Departmental Representative.
- .5 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- .6 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste as recommended by flooring manufacturer for use with their product.
- .7 Metal edge strips:
 - .1 Aluminum extruded, smooth, with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

Part 3 Execution

3.1 EXAMINATION

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

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 SITE VERIFICATION OF CONDITIONS

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

3.3 PREPARATION

- .1 Remove existing resilient flooring.
- .2 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.
- .3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .5 Seal concrete slab to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least 1 month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .4 Run sheets in direction of traffic. according to manufacturer's printed instructions.
- .5 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.
- .6 Cut flooring around fixed objects.
- .7 Install feature strips and floor markings where indicated. Fit joints tightly.
- .8 Continue flooring over areas which will be under built-in furniture.
- .9 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 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.
 - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.

3.6 PROTECTION

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.
- .3 .

END OF SECTION

Part 1 DEPARTMENTAL REPRESENTATIVE General

1.1 RELATED SECTIONS

- .1 Section 09 21 16: Gypsum Board Assemblies.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition].
 - .2 Maintenance Repainting Manual - [current edition].
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Submit two (2) 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 Provide and maintain dry, temperature controlled, secure storage.
- .2 Store painting materials and supplies away from heat generating devices.
- .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
 - .1 Supply one (1) 9 kg Type ABC fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada (NFC) requirements.

1.5 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 50 00 - Temporary Facilities and Controls.
 - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
 - .1 Use MPI listed materials having E2 rating where indoor air quality requirements exist.
 - .1 Primer: VOC limit 100 g/L maximum to GS-11.

- .2 Paint: VOC limit 100 g/L maximum to GS-11.
- .4 Colours:
 - .1 Submit proposed Colour Schedule to Departmental Representative for review.
 - .2 Base colour schedule on selection of one (1) base colour.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
 - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
 - .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss	Finish	Gloss @ 60 deg.	Sheen @ 85 deg.
1	Matte (flat)	Max. 5	Max. 10
2	Velvet-Like	Max.10	10 to 35
3	Eggshell	10 to 25	10 to 35
4	Satin	20 to 35	min. 35
5	Semi-Gloss	35 to 70	
6	Gloss	70 to 85	
7	High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.
- .7 Exterior painting:
 - .1 Concrete Vertical Surfaces: (including horizontal soffits)
 - .1 EXT 3.1A - Latex gloss level 3 finish.
 - .2 Concrete Masonry Units: smooth and split face block and brick
 - .1 EXT 4.2A - Latex finish.
 - .3 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 EXT 5.1D - Alkyd gloss level 5 finish.
 - .4 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 EXT 5.3B - Alkyd gloss level 5 finish.
 - .5 Dimension Lumber: columns, beams, exposed joists, underside of decking, siding, fencing, etc.
 - .1 EXT 6.2L - Semi-transparent stain finish.

- .6 Dressed Lumber: doors, door and window frames, casings, battens, smooth facias, etc.
 - .1 EXT 6.3D - Semi-transparent stain finish do not use on doors.
REX 6.3B - Alkyd match existing adjacent finish.
REX 6.3D - Semi-Transparent Stain.
- .8 Interior painting:
 - .1 Concrete horizontal surfaces: floors.
 - .1 INT 3.2B - Alkyd floor enamel gloss level 6 finish.
 - .2 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 INT 5.1E Alkyd - gloss level 5 finish.
 - .3 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 INT 5.3C - Alkyd gloss level 5 finish (over cementitious primer).
 - .4 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 INT 6.3A - Latex [gloss level 5] finish.
 - .2 INT 6.3B - Alkyd gloss level 5 finish.
 - .3 INT 6.3K - Polyurethane varnish [gloss level 3] finish.
 - .5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2A - Latex gloss level 3 finish (over latex sealer).

Part 3 Execution

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

3.2 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

- .1 Protection of in-place conditions:

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
 - .7 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by Departmental Representative
- .2 Use method of application approved by Departmental Representative.
 - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines.
- .7 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .8 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
 - .2 Do not paint over nameplates.

- .3 Keep sprinkler heads free of paint.
- .4 Paint fire protection piping red.
- .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .6 Paint natural gas piping yellow.
- .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
- .8 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 recycling in accordance with Section 01 74 22 – Construction Demolition Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Place paint and primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Divisions 22 and 23.

1.2 ACTION AND INFORMATIONAL SUBMITTAL

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Drawings and product data accompanied by:
 - .1 Acoustical sound power data, where applicable.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify current model production.
 - .4 Certification of compliance to applicable codes.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The drawings and specifications are performance based or based upon manufacturers whose products are specified for installation in the work. Additional manufacturers have been approved and are listed within.
- .2 Any other manufacturer requesting "approved Equal" must receive written approval from the Departmental Representative.
- .3 Approved manufacturers products shall meet the design characteristic requirements as indicated and conform to space limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
-

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

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

3.4 PAINTING REPAIRS AND RESTORATION

- .1 Return to new conditions to approval of Departmental Representative.
- .2 Prime and touch up marred finished paint work to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.5 DEMONSTRATION

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

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

1.2 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .5 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
 - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.
-

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Coordinate with Departmental Representative's occupancy requirements during selective demolition and schedule activities in accordance with Section 01 32 16 - Construction progress Schedule.

1.5 QUALITY ASSURANCE

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

1.6 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
 - .2 Existing Hazardous Substances: Departmental Representative performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in the Work.
 - .1 Hazardous substances will be removed by a hazardous abatement specialist engaged by the Departmental Representative before start of the Work.
 - .3 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in the Hazardous Products Act.
 - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
 - .4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
-

- .1 Hazardous substances will be as defined in the Hazardous Products Act.
- .2 Stop work in the area of the suspected hazardous substances.
- .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
- .4 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to the Work.
- .5 Proceed only after written instructions have been received from Departmental Representative.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- .1 General Patching and Repair Materials: Refer to Section 02 41 00.08 for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .3 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 (SALVAGE AND) DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative property.
 - .2 Salvaged Materials: Carefully remove materials designated for salvage and store in a manner to prevent damage or devaluation of materials.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section as follows:
 - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active or energized utilities without approval of the Departmental Representative.
-

.3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.

.4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.5 At end of each day's work, leave worksite in safe condition.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 in. (12 mm) through 3 in. (76 mm), for Water Service.
 - .2 American Society For Testing and Materials (ASTM)
 - .1 D1784-11, Standard Specification For Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - .2 ASTM D2467-15, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - .3 ASTM F876-17, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
 - .4 ASTM F877-18, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.
 - .5 F1970-12e1, Standard Specification for Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly Vinyl Chloride) (CPVC) Systems.
 - .6 ASTM F1960-15, Standard Specification For Cold Expansion Fittings With PEX Reinforcing Rings For Use with Crosslinked Polyethylene (PEX) Tubing.
 - .3 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B2.1, Pipe Treads
 - .4 CSA Group
 - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .3 CSA B137.6-17, PVC Pipe Tubing and Fittings.
 - .5 Health Canada workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-17, Butterfly Valves.
 - .2 MSS-SP-70-11, Gray Iron Gate Valves, Flanged and Threaded Ends.
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- .3 MSS-SP-71-11, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80-13, Bronze Gate, Globe, Angle and Check Valves.
- .7 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC), 2015.
- .8 National Sanitation Foundation (NSF)
 - .1 NSF 61, Potable Water System.
- .9 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous materials and Assemblies.
 - .3 CAN/ULC S115-11, Standard method of Fire Tests of Firestop.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Manufacturer's Instructions.
 - .2 Place materials defined as hazardous or toxic in designated containers.
 - .3 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
-

PART 2 - PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: NPS 1/2 to 4 CPVC to SDR11 with IPS outside dimensions: CSA B137.6, ASTM D1784 cell class of 24448 and NSF 61.
 - .2 NPS 1/2 to 3 PEX Piping to CSA B137.5,877.
 - .3 Buried or embedded:
 - .1 PEX Piping to CSA B137.5.
 - .2 Up to NPS 3: PEX Tubing to ASTM F876 and F877 and certified to NSF 61 rated at 93° at 551 kPa, 82°C at 690 kPa, 23°C at 1100 kPa, certified to be used for hot or cold water service.

2.2 FITTINGS

- .1 CPVC Fittings: to CSA B137.6, ASTM D1784 Cell Class of 23447 and NSF 61.
- .2 CPVC Flanges: to ASTM F1970 and ASTM D2467.
 - .1 Flanged CPVC: 1034 kPa at 23°C, 517 kPa t 60°C not to be used above 60°C.
 - .2 Bolt hole patterns to ASME B16.1 Class 125, threads to be tapered iron pipe size threads to ANSI B2.1.
- .3 Transition points: as recommended by manufacturer.
- .4 PEX fittings certified to CSA B137.5, ASTM F876 and ASTM F877, and certified to be used with PEX tubing.
 - .1 PEX fittings to CSA B137.5.

2.3 JOINTS

- .1 NPS 1 1/2 and smaller: PEX fittings to CSA B137.5 or CPVC solvent weld to ASTM D2467.
- .2 NPS 2 and larger: PEX fittings to CSA B137.5 and ASTM F1960, elbows, adapters, couplings, plugs, tees, multi-port tees and valves or CPVC solvent weld to ASTM D2467.

2.4 GATE VALVES

- .1 NPS 2 and under, screwed:
-

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

2.5 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze Forged or Brass body, chrome plated brass or stainless steel ball, PTFE adjustable packing, brass gland and PTFE BunaN or TFE seat, steel lever handle as specified in Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass or stainless steel ball, PTFE adjustable packing, brass gland and PTFE or BunaN seat, steel lever handle, with NPT to copper adaptors as specified in Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 and under socket solvent weld:
 - .1 CPVC to ASTM D1784 Cell Class 23567-A.
 - .2 NSF 61 Certified, 1585 kPa.
 - .3 Full Port, fully blocking, safety shear stem design.
 - .4 827 kPa at 60°C.

2.6 SWING CHECK VALVES

- .1 NPS-2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified in Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified in Section 23 05 23.01 - Valves - Bronze.
 - .3 NPS 2 and under, socket:
 - .1 NPF 3/4-4, ball check, solvent weld CPVC.
 - .2 Built-in union design.
 - .3 Free floating ball.
 - .4 Uniseat seal.
-

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with NPC Plumbing Code and manufacturer's recommendations.
- .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .3 Install CWS piping below and away from HWS and other hot piping so as to maintain temperature of cold water as low as possible.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .6 Valves:
 - .1 Isolate equipment, fixtures and branches with gate or ball valves.
 - .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of the National Plumbing Code.
 - .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.
-

3.4 FLUSHING AND CLEANING

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

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative.

3.7 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
 - .2 Provide continuous supervision during start-up.
 - .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring HWS storage tank up to design temperature slowly.
 - .4 Monitor piping hot and free recirculation piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
 - .4 Rectify start-up deficiencies.
-

3.8 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 TAB recirculation system in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize hot and recirculation systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with safety and health requirements.
 - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor. Repeat for outlets and flush valves.
 - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

- .1 Coordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products.

3.10 CLEANING

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

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and vent piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 32-08(2014), Specification for Solder Metal.
 - .2 ASTM B 306-13, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564-14, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-12, Plumbing Fittings.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary and vent Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: tin-lead, 50:50, type 50A, lead free 95:5, type TA, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm and vent minimum NPS 2, to: CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.
 - .2 Stainless steel clamps.
 - .2 Aboveground sanitary and vent to CAN/CSA-B70.
-

- .1 Joints:
 - .1 Mechanical joints: Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Pipe materials to be in accordance with the Canadian Plumbing Code.

3.2 TESTING

- .1 Pressure test buried systems before backfilling shall consist in applying a water column of at least 3m to all joints. According to NPC 2015.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (sanitary, vent) c/w directional arrows every floor or 4.5 m (whichever is less).

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM D 2235-04(2016), Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564-12, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-Series B1800-15, Plastic Nonpressure Pipe Compendium.
 - .2 CSA/CSA B1800-15, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
 - .3 CSA-B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- .1 For buried and above ground DWV piping to:
 - .1 CSA/CSA B1800.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with National Plumbing Code and local authority having jurisdiction.
 - .2 Plastic piping used in exposed locations or return air ceiling plenums must have a smoke/flame spread rating of 50/25.
-

3.2 TESTING

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

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (sanitary, vent, etc.) c/w directional arrows every 4.5 m.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA C22.2 No. 110-94(R2004), Construction and Test of Electric Storage Tank Water Heaters.
 - .3 CSA B64-SERIES-2011, Backflow preventers and Vacuum Breakers.
 - .4 CAN/CSA-C191-13, Performance of Electric, Storage Tank Water Heaters for Household Service.
 - .5 CAN/CSA-C309-M90(R2003), Performance Requirements or Glass-lined Storage Tanks for Household Hot Water Services.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

- .1 To CAN/CSA 22.2 No. 110, CAN/CSA-C191 and CAN/CSA-C309 for glass-lined storage tanks, with two (2) immersion type elements, 4500 W each surface mounted or immersion type adjustable thermostats.
 - .2 Tank: 279 L glass lined steel, 610 mm diameter x 1520 mm high, 50 mm mineral wool or fibreglass insulation, enamelled steel jacket, 3 year warranty certificate. Tanks have to fit through 923 mm x 923 mm opening.
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-
- .3 Electrical: 240 V / 1 Ph / 60 Hz

2.2 TRIM AND INSTRUMENTATION

- .1 Drain valve.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
- .3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.
- .4 ASME rated temperature and pressure relief valve sized for full capacity of heater having discharge terminating in location approved by Departmental Representative.
- .5 Magnesium anodes adequate for 20 years of operation and located for easy replacement.
- .6 Certified diaphragm type potable water expansion tank to 22 42 01, properly sized for use with domestic hot water heater identified in this section.
- .7 Vacuum Breakers: to CSA B64, atmospheric type.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Install water expansion tank on cold water supply side of domestic hot water heater.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Technician to start up and commission DHW heaters.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Waste Management and Disposal.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A126-04(2014), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-15, Specification for Composition Bronze or Ounce Metal Castings.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B64-Series-11(R2016), Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08(R2013), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CAN/CSA-B356-10(R2015), Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
 - .2 PDI-WH201-92, Water Hammer Arresters Standard.
- .4 National Sanitation Foundation (NSF)
 - .1 NSF 61-2014, Drinking Water System Components.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Data to include:
-

- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

- .1 Floor drains: to CSA B79.
- .2 General duty: cast iron body round, adjustable head, nickel bronze adjustable strainer, integral seepage pan, trap primer or trap guard and clamping collar.

2.2 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, polished nickel bronze round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover: nickel bronze, round, gasket, vandal proof screws.

2.3 WATER HAMMER ARRESTORS

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

2.4 VACUUM BREAKERS

- .1 Breakers: to CSA B64-Series-11 Series, vacuum breaker atmospheric type.
-

2.5 HOSE BIBBS AND SEDIMENT FAUCETS

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

2.6 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS2 and under, bronze body, screwed ends with brass cap.

2.7 EXPANSION TANKS

- .1 NSF-61 certified, diaphragm type.
- .2 ASME rated pressure relief valve sized for full capacity of expansion tank.
- .3 Factory pre-charge. Brass air valve with o-ring seal.

2.8 NON-FREEZE WALL HYDRANTS

- .1 Surface mount with integral vacuum breaker, NPS 1/2 hose outlet, removable operating key. Chrome plated or Polished bronze finish.

2.9 PRESSURE REGULATORS

- .1 Capacity/Size: full flow pump conditions.
 - .1 Inlet pressure: Up to 1034 kPa.
 - .2 Outlet pressure: Adjustable down to to 207 kPa.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.
- .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.10 TRAP SEAL PRIMER

- .1 Brass, with integral vacuum breaker, NSP 1/2 solder ends, NPS 1/2 drip line connection.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

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

3.5 TRAP SEAL PRIMERS

- .1 Install for all floor drains.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space.
- .3 Install soft copper or plastic tubing to floor drain.

3.6 HOSE BIBBS AND SEDIMENT FAUCETS

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

3.7 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.8 EXPANSION TANKS

- .1 Coordinate installation with Departmental Representative.
- .2 Install for protection against expansion in accordance with National Plumbing Code of Canada.
- .3 Install pressure relief valves and low point drains on each expansion tank. Pipe to locations approved by Departmental Representative.

3.9 START-UP

- .1 Timing: Start-up only after:
 - .1 Pressure tests have been completed.
- .2 Provide continuous supervision during start-up.

3.10 TESTING AND ADJUSTING

- .1 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
 - .2 Applicable tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
-

- .2 Flow rate at fixtures: +/- 20%.
- .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawals if (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Floor drains:
 - .1 Verify operation of trap seal primer or trap guard.
 - .2 Prime using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
- .5 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .6 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .7 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.
- .8 Access doors/panels:
 - .1 Verify size and location relative to items to be accessed.

3.11 PROTECTION

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-B45 Series-02(R2013), Plumbing Fixtures.
 - .2 CAN/CSA-B125.3-12, Plumbing Fittings.
 - .3 CAN/CSA-B651-12, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
 - .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
 - .3 Exposed plumbing brass to be chrome plated.
 - .4 Number, locations: architectural drawings to govern.
 - .5 Fixtures to be product of one manufacturer.
 - .6 Trim to be product of one manufacturer.
 - .7 Kitchen hand wash sink.
 - .1 Single compartment, undermount.
 - .1 From 1.43 mm thick type 304 stainless steel, self-rimming, undercoated, mounting clips, polished satin finish, 89 mm straighter, rear center. Inside sizes: 305 W x 431 L x 229 D mm.
 - .2 Trim: stainless steel, single hole, with mixing lever on side, swivel spout, 6.6 LPM, ceramic discs, spout swivel range 180°.
 - .8 Seawater/Freshwater sink and staff rooms undermount.
 - .1 From 1.59 mm Type 304 stainless steel, sound guard, mounting clips, polished satin finish, 39 mm strainer, rear centre. Inside Dimensions: 400 W x 584 L x 203 D.
 - .2 Trim: stainless steel, single hole, with mixing lever on side, swivel spout, 6.6 LPM, ceramic discs, spout swivel range 180°.
 - .9 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated rigid flexible supply pipes each with screwdriver handwheel stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
 - .10 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.
-

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA-B651.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .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 19 - Waste Management and Disposal.

PART 1 - GENERAL

1.1 USE OF SYSTEMS

- .1 Use of new permanent HVAC systems for supplying temporary heat, ventilation, or cooling is not permitted.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

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

1.2 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
-

.1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Departmental Representative continued occupancy requirements during selective demolition with Section 02 41 00.08 and schedule staged occupancy and worksite activities as a defined Critical Path Activity item in accordance with Section 01 32 16 - Construction Progress Schedule.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following:
 - .1 Federal Workers' Compensation Service.
- .2 Government of Canada, Labour Program: Workplace Safety.

1.6 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted or at time of site examination before tendering.
 - .2 Existing Hazardous Substances: Departmental Representative performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in the Work.
 - .1 Hazardous substances will be removed by a hazardous abatement specialist engaged by the Departmental Representative before start of the Work.
 - .3 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
-

- .1 Hazardous substances are as defined in the Hazardous Products Act.
- .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Hazardous substances will be as defined in the Hazardous Products Act.
 - .2 Stop work in the area of the suspected hazardous substances.
 - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .4 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to the Work.
 - .5 Proceed only after written instructions have been received from Departmental Representative.

PART 2 - PRODUCTS

2.1 REPAIR MATERIAL

- .1 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .2 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 (SALVAGE AND) DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative property.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section and as follows:
 - .1 Disconnect electrical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active or energized utilities without approval of the Departmental Representative.
-

.3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.

.4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.5 At end of each day's work, leave worksite in safe condition.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-2015, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 National Electrical Manufacturers Association (NEMA)
- .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.
- .3 Quality Control: in accordance with Section 01 45 00 - Testing and Quality Control.
 - .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.
- .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 CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
-

- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local electrical power company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (1/2 HP) and larger: NEMA Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.
- .4 Provide inverter duty motors for variable speed applications.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.
-

2.4 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 Correct size of sheave determined during commissioning.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 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.

3.3 CLEANING

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

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

1.2 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 Ball valves
 - .4 Syphons
 - .5 Wells

1.3 HEALTH AND SAFETY

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
 - .2 Ranges: as required. High and low readings fall within scale or range.
-

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to ASME B40.200.

2.3 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel or 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 Gasketed pressure relief back with solid front.
 - .4 NPS 1/4 ball valve for gauge isolation.
 - .5 Oil filled for high vibration applications (i.e. pumps, compressors).

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
 - .2 Install in locations as indicated and on inlet and outlet of:
 - .1 DHW heaters.
 - .3 Install wells for balancing purposes.
-

- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install pressure gauges in following locations:
 - .1 At expansion tanks.
 - .2 At water supply building entrance.
 - .3 In other locations as indicated.
- .2 Install ball valves for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

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(R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 276-10, Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-12, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B505M-12a, Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-25-2013, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
 - .3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Submit data for valves specified in this section.
 - .4 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
-

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY STORAGE AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All 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 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
 - .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
 - .3 NPS 2 and under, rising stem, split wedge disc, Class 125:
-

- .1 Body: with long disc guides, screwed bonnet.
- .2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
- .3 Operator: Handwheel Lockshield.
- .4 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 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.
- .6 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class 125.
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders, or solder ends to ANSI or as required.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel or hard chrome solid ball and teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
 - .9 Include valve stem extension for insulated piping where operation will impact on insulation.

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.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2010, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 125-96(2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-12, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .6 Underwriter's Laboratories of Canada (ULC)

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
 - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .4 Closeout Submittals:
-

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

1.3 QUALITY ASSURANCE

.1 Health and Safety:

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

1.4 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 19 - Waste Management and Disposal.

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 MSS SP 58 or ASME B31.1.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP 58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are 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: 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved to MSS-SP 58.
 - .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved to MSS SP 58.
 - .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 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
 - .5 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel, black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for insulated pipework.
-

- .4 Oversize pipe hangers and supports.
- .6 Adjustable clevis: material to MSS SP 58 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 58.
- .8 U-bolts: carbon steel to MSS SP 58 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black, except galvanized in wash bays.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 58.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 58, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 58.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.
-

2.7 OTHER PIPING AND EQUIPMENT SUPPORTS

- .1 Fabricate other piping and equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at evaporator and condensing units and as indicated.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code authority having jurisdiction.
- .2 Flexible joint roll groove pipe: in accordance with manufacturer's recommendations.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
-

- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Testing and Quality Control and submit report as described in PART 1 - SUBMITTALS.
 - .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
-

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Building Code of Canada (NBC)- 2015.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of workplace Hazardous Materials Information system (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide separate shop drawings for each isolated system, system shop drawings complete with performance and product data.
 - .2 Indicate interior bases and locate vibration isolators, with static and dynamic loads on each.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Product Data: Provide schedule of vibration isolator type with location and load on each.

1.3 QUALITY ASSURANCE

- .1 Health and Safety:
-

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

1.4 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Size and shapes of bases type and performance of vibration as indicated.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm minimum thick; 50 durometer; maximum loading 350 kPa.
 - .2 Type EP2 - rubber waffle or ribbed 10 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
 - .3 Type EP3 - neoprene-steel-neoprene; 10 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
 - .4 Type EP4 - rubber-steel-rubber; 10 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.
-

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor and 100% relative humidity installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
 - .2 Type M2 - stable open spring: support on bonded 6mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
 - .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
 - .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
 - .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
 - .6 Performance: 50 mm static deflection unless noted otherwise.
-

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.
- .6 Performance: as required.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC 2015.
 - .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
 - .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
 - .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.
-

- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for all rotating equipment listed below:
 - .1 Fans.
 - .2 Packaged equipment with motorized components, excluding motorized valve actuators.
 - .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .5 Submit complete report of test results including sound curves.

3.4 CLEANING

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

PART 1 - GENERAL

1.1 SUBMITTALS

- .1 Product Data
 - .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product data to include paint colour chips, other products specified in this section.
 - .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.2 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.3 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
-

- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows.
 - .2 Pictograms:
-

- .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
- .1 Block capitals to sizes and colours.
- .4 Arrows showing direction of flow:
- .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
- .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
- .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
- .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
- .1 Where not listed, obtain direction from Departmental Representative.
- .2 Colours for legends, arrows: to following table:
- | | |
|--------------------|-----------------|
| Background colour: | Legend, arrows: |
| Yellow | BLACK |
| Green | WHITE |
| Red | WHITE |

.3 Background colour marking and legends for piping systems:

Contents	Background colour	Legend Marking
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Seawater	Green	SEA WATER
Refrigerant suction	Yellow	REF SUCTION
Refrigerant liquid	Yellow	REF. LIQUID
Refrigerant Hot Gas	Yellow	REF. HOT GAS

2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high, e.g. AHU-1 Supply, F-1 Exhaust.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.5 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.6 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.

2.7 LANGUAGE

- .1 Identification in English.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 00 - Painting, has been completed.
-

3.3 INSTALLATION

- .1 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
-

- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Number valves in each system consecutively.

3.7 CLEANING

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

PART 1 - GENERAL

1.1 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 Firms must be certified to AABC or NEBB Standards.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
-

- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 22 and 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:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, caulking.
 - .1 All pressure, leakage, other tests specified elsewhere Divisions 22 and 23.
 - .2 all provisions for TAB installed and operational
-

- .3 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 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.
 - .2 Hydronic systems: plus or minus 5%.

1.11 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format to be in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
 - .2 Provide manpower and instrumentation to verify up to 30 % of reported results.
 - .3 Number and location of verified results to be at discretion of. Departmental Representative.
 - .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.
-

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
 - .2 Do TAB of systems, equipment, components, controls specified in Divisions 22 and 23.
 - .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
 - .4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.
 - .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
 - .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
 - .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
-

1.20 DOMESTIC SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
- .2 Do TAB of systems, equipment, components, controls specified in Divisions 22 and 23.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .4 Quality Assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Location of equipment measurements: to include, but not be limited to, the following as appropriate: inlet and outlet of heaters, booster pumps at controllers and controlled devices.
- .6 Locations of systems measurements to include, but not be limited to, the following, as appropriate: main, main-branch, branch, sub-branch.

1.21 OTHER SYSTEMS

- .1 Plumbing systems:
 - .1 TAB procedures:
 - .1 Flush valves: adjust to suit project pressure conditions.
 - .2 Trap primer: adjust to proper operation.
 - .3 Pressure booster pump: adjust to proper pressure.

1.22 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.
-

PCA 1326 Terra Nova
Parks Canada
Terra Nova, NL

TESTING,
ADJUSTING AND
BALANCING FOR
HVAC

Section 23 05 93
Page 7

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
 - .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
 - .3 Submit details of test instruments to be used to Departmental Representative at least three months before anticipated start date.
 - .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
 - .5 Re-calibrated every six months thereafter.
-

2.2 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 2%.

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 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
 - .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
 - .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.
-

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

- .1 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.
- .2 Verification requirements to include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified Wood.
 - .8 Low-emitting materials.
- .3 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.6 CLEANING

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

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-2013, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B 209M-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449-07(R2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547-15, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553-13, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612-14, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795-08(R2013), Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C 921-10(R2015), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-11, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
-

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

- .2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.5 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have experience in this size and type of project, member of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management And Disposal.
-

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: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C 553.
 - .2 Maximum "k" factor: to ASTM C 553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
-

- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face.
- .12 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.
- .13 Surfaces clean, dry, free from foreign material.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
 - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
 - .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
 - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
-

- .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, maximum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular supply and exhaust air ducts	C-1	yes	25
Round supply and exhaust air ducts	C-2	yes	25

- .2 Finishes: conform to following table:

Indoor concealed	none	none
Indoor exposed	Canvas	Canvas

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-2015, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-13, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-12, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
 - .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 2005).
 - .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-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
-

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.3 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 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 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this Section, with successful experience in this size and type of project, qualified to standards member of TIAC.
-

- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - 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.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
-

- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702, ASTM C 547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
 - .3 Ensure type A-1 insulation on steam piping is rated for required temperature.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .5 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint by Departmental Representative.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.
- .3 Stainless steel:
 - .1 Type: 316.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: corrugated.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 00 - Joint Sealant.
-

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 Surface clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, 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: PVC.
-

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS wire or band at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS wire or bands at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements: as recommended by manufacturer.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applic ation	Temp degrees	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
-----------------	-----------------	--------------	--	--	--	--	--	--

			Run out	to 1 2	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant		A-6	25	25	25	25	25	25

- .6 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: water-proof SS jacket.
- .6 Finish attachments: SS screws or bands, at 150 mm on centre. Seals: wing closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society For Testing and Materials (ASTM)
 - .1 D1784-11, Standard specification For Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Polychlorid
 - .2 ASTM D2467-15, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - .3 F1970-12e1, Standard Specification for Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly Vinyl Chloride) (CPVC) Systems.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B2.1, Pipe Treads
- .3 CSA Group
 - .1 CSA B137.6-17, PVC Pipe Tubing and Fittings.
- .4 Health Canada workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-122-2017, Plastic Industrial Ball Valves.
- .6 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous materials and Assemblies.
 - .3 CAN/ULC S115-11, Standard method of Fire Tests of Firestop.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Manufacturer's Instructions.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Piping, within building.
 - .1 Above ground: NPS 1/2 to 4 CPVC to Schedule 80 with IPS outside dimensions: ASTM D1784 cell class of 24448.

2.2 FITTINGS

- .1 PVC Fittings: to ASTM D1784 Cell Class of 23447 and NSF 61.
- .2 PVC Flanges: to ASTM F1970 and ASTM D2467.
 - .1 Flanged PVC: 1034 kPa at 23°C, 517 kPa at 60°C not to be used above 60°C.
 - .2 Bolt hole patterns to ASME B16.1 Class 125, threads to be tapered iron pipe size threads to ANSI B2.1.
- .3 Transition points: as recommended by manufacturer.

2.3 JOINTS

- .1 NPS 1/2 to 2: Solvent cement.
 - .2 NPS 2 1/2 to 4: Flange fittings.
-

2.4 BALL VALVES

- .1 NPS 2 and under: Solvent cement.
 - .1 Pressure Rating: 155 kPa (230 PSI).
 - .2 PVC body to ASTM A1784, Full port, fully blocking, safety shear stem, union end.
- .2 NPS 2 1/2 to 4:
 - .1 PVC body to ASTM A1784, full port, fully blocking, safety shear stem.
 - .1 Union end with ANSI flanges, union nut.

2.5 SWING CHECK VALVES

- .1 NPS 3/4 to 4:
 - .1 Pull body and internals to ASTM A1784, one piece molded flanged body, low pressure drop.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with Manufacturer's Instructions.
- .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .4 Valves:
 - .1 Isolate equipment, fixtures and branches with ball valves.

3.3 PRESSURE TESTS

- .1 Conform to requirements of the National Plumbing Code.
-

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

3.4 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that air chambers, expansion compensators are installed properly.

3.5 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.6 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
 - .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .3 Reports:
 - .1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.
-

3.7 OPERATION REQUIREMENTS

- .1 Coordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products.

3.8 CLEANING

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect pumps from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SINGLE SUCTION CENTRIFUGAL PUMP

- .1 General:
 - .1 Pump to self-priming and constructed with all wetted components either of polypropylene (PP) or polyvinylidene fluoride (PVDF) solid homogeneous thermoplastic materials. Temperatures to 275°F (135°C). Pumps to be self-priming to 15 feet (4.6m).
- .2 Priming Chamber;
 - .1 Integrally molded, one-piece thermoplastic component incorporating accessible check valve, and unique inner fluid passage design. Pump to assure automatic holding of prime on shut down, unless drained for maintenance.
- .3 Pump Cover and Casing Assembly:
 - .1 Injection molded from homogeneous thermoplastic material selected for compatibility with the fluids being pumped. These are to be solid, not lined, components.
- .4 Impeller:
 - .1 Thermoplastic material, injection molded with an embedded dynamically balanced stainless steel insert with radial vanes. It shall be of semi open vane design with keyway for mounting on shaft to assure positive drive.
- .5 Pedestal:
 - .1 Designed with a wide open seal area sized to accommodate reverse mounted single or double mechanical seals. It shall incorporate a set of parallel sliding bars to permit easy adjustment and positioning of the front bearing assembly without disturbing shaft alignment. Pedestal to incorporate back pullout design per ANSI specifications.

-
- .6 Shaft and Bearing Assemblies:
 - .1 Shaft to be precision machined, stainless steel with the wetted end totally sleeved in thermoplastics. It shall be guided by two heavy-duty self-aligning bearings widely spaced for maximum stability and extended life.
 - .7 Suction Port:
 - .1 Construction to permit 360 degrees rotation.
 - .8 External Armor:
 - .1 The cast iron protective armor surrounding the pump casing to be painted with two-part chemical resistant epoxy resin or similar coating material.
 - .9 Factory Testing:
 - .1 Each pump to be tested to assure performance at conditions of service. Test data to be permanently recorded are retrievable on request.
 - .10 Performance: 3.2 L/S (50 GPM) at 22.9m (75 FZ Head), 2 HP 230/1/60.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic pump installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

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

3.3 INSTALLATION

- .1 Base mounted type: supply templates for anchor bolt placement.
 - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
 - .2 Align coupling in accordance with manufacturer's recommended tolerance.
 - .3 Check oil level and lubricate. After run-in, tighten glands.
- .2 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .3 Pipe drain tapping to floor drain.
- .4 Install volute venting pet cock in accessible location.
- .5 Check rotation prior to start-up.
- .6 Install pressure gauge test cocks.

3.4 START-UP

- .1 General:
 - .1 In accordance with manufacturer's recommendations.
 - .2 Procedures:
 - .1 Before starting pump, check that water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility.
 - .11 Eliminate cavitation, flashing and air entrainment.
 - .12 Adjust pump shaft seals, stuffing boxes, glands.
 - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
-

- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

- .1 Verify that manufacturer's performance curves are accurate.
- .2 Ensure valves on pump suction and discharge provide tight shut-off.
- .3 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
- .4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .5 Commissioning Reports: Reports to include:
 - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Pump performance curves (family of curves).

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-2011, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-2013, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-2013, Refrigeration Piping.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A307-14, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B280-13, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B52-13, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
- .5 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .6 Province of Newfoundland and Labrador Boiler, Pressure Vessel and Compressed Gas Regulations.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280-13, type ACR B.
 - .2 Annealed copper: to ASTM B280-13, with minimum wall thickness as per ASTM B644-11 and ASME B31.5-2013.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121°C, with CRNs.
-

- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver, copper-phosphorous, 95% 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 (WITH CRNs)

- .1 22 mm and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .3 6 mm to 80 mm: Class 4.8 MPa, ball type, valve body, body adapter, ball and seal cap brass, stem plated steel, pipe extension copper. Ball seals PTFE, stem o-ring and cap seal neoprene, brazed ends, blowout proof stem, ball cavity vented, schrader valve.

PART 3 - EXECUTION

3.1 GENERAL

- .1 In accordance with manufacturer's installation instructions and recommendations, supplemented as specified herein.
- .2 Install in accordance with CSA B52-09, EPS1/RA/1 and ASME B31.5-2001.

3.2 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
-

- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.3 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constricting Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified above.
 - .2 Small riser: size for 5.1 m/s at minimum load.

3.4 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52-13 before evacuation to 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND CHARGING

- .1 Close service valves on factory charged equipment.
 - .2 Ambient temperatures to be at least 13° C for at least 12 hours before and during dehydration.
 - .3 Use copper lines of largest practical size to reduce evacuation time.
-

-
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
 - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
 - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14kPa.
 - .3 Final to 5Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
 - .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
 - .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.

3.6 INSTRUCTIONS

- .1 Post instructions in frame with glass cover in accordance with Section 01 77 00 - Closeout Procedures and CSA B52-09.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 480/A 480M-10, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-09, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-09, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012, 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007 2nd Edition.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material.

1.3 QUALITY ASSURANCE

- .1 Certification of Ratings:
-

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

.1 Do Construction Occupational Health and Safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, seal and tape or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
 - .2 Radiused elbows.
 - .1 Rectangular: Centreline radius: 1.5 times width of duct. Unless noted otherwise.
 - .2 Round: smooth radius or five piece if required. Centreline radius: 1.5 times diameter.
 - .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
 - .4 Branches:
 - .1 Rectangular main and branch: 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with balancing damper.
 - .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
 - .6 Offsets:
 - .1 Full radiused elbows.
 - .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.
-

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M-09, G90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.
- .3 Joints: to ASHRAE, SMACNA, and proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC piping and equipment.
- .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hangers: 500 mm.
- .3 Hanger configuration: to ASHRAE and SMACNA.
- .4 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 X 25 X 3	6
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

- .5 Upper hanger attachments:
 - .1 For joist: manufactured joist clamp, or steel plate washer.
 - .2 For beams: manufactured beam clamps.
-

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE, SMACNA and as indicated.
- .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 ASHRAE 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 Fresh air intakes including combustion air systems.
 - .2 Exhaust stacks from base of riser upwards.
 - .3 Minimum 3000 mm from duct mounted humidifier in all directions.
 - .4 As indicated.
 - .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder weld joints of bottom and side sheets.
-

.2 Seal other joints with duct sealer.

- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer and discharging to open funnel drain.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 DUCT MATERIALS

- .1 Ducts shall be constructed of the following materials unless indicated otherwise.
- .1 Interior duct systems: galvanized steel.
 - .2 Exterior duct systems and components: stainless steel or aluminum.

3.6 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.

3.7 FIELD QUALITY CONTROL

- .1 Contractor's Verification, include:
- .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
-

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- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Low-emitting materials.

PART 1 - GENERAL

1.1 REFERENCES

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

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
- .3 Submit WHMIS MSDS.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

- .1 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40° C to plus 90° C, density of 1.3 kg/m².

2.3 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

2.4 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: to sash locks complete with safety chain for hand entry.
 - .2 600 x 600 mm: piano hinge and minimum two sash locks for body entry.

2.5 TURNING VANES

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

2.6 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 sheets.

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.

3.3 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 00 - Cleaning and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
-

- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings or self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage : 2% at 500 Pa.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
-

3.2 INSTALLATION

- .1 Install where indicated.
- .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 Departmental Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/AMCA Standard 500-D-07, Laboratory Methods of Testing Dampers for Rating.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Performance data, leakage at closed position, pressure drop, torque required.

1.3 CLOSEOUT SUBMITTALS

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

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Parallel blade type only for on/off service unless otherwise indicated, thermally insulated frame and blades.
 - .2 Extruded aluminum (6063T5) frame, 2.03 mm thickness, extruded aluminum interlocking blades, complete with extruded silicon seals, spring stainless steel side seals, extruded aluminum frame.
-

- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
 - .1 Leakage: in closed position to be less than 0.001% rated flow at 1000 Pa differential across damper.
 - .2 Pressure drop: at full open position to be less than 12 Pa differential across damper at 4 m/s.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.
- .7 Temperature range: dampers and scale materials to be suitable for -40°C to +68°C.

2.2 BACKDRAFT DAMPERS

- .1 Automatic gravity operated, multi-leaf, steel construction with nylon bearings, centre pivoted.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .4 Ensure dampers are observable and accessible.

3.2 CLEANING

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

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

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112-90 (R2001), Fire Test of Fire Damper Assemblies.
 - .2 ULC-S505, Fusible Links for Fire Protection Service.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 80, standard for Fire Doors and Other Opening Protectives, 2010 Edition.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Fire stop flaps.
 - .3 Operators.
 - .4 Fusible links.
 - .5 Design details of break-away joints.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout 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.
-

1.4 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Procedures.
- .2 Provide following:
 - .1 Three (3) fusible links of each type.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement to have blades out of airstream, listed and bear label of ULC, and meet requirements of CFFM and ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
 - .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: ratings to match fire rated separation.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
 - .3 Top hinged: offset single damper, round or square; sized to maintain full duct cross section.
 - .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
 - .1 Activation temperature: 74 deg. C, unless noted otherwise.
-

- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed in order not to disrupt ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .11 All dampers to be functionally tested after installation. Provide tag near access verifying test.

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 in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
 - .2 Maintain integrity of fire separation.
 - .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
 - .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
-

- .5 Coordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.
- .8 Dampers shall be installed with its centerline located in the centerline of the fire separation depth or thickness.

3.3 TESTING

- .1 All fire damper shall be inspected and tested as per NFPA 80.
- .2 Each fire damper shall be tagged following testing, and the tag shall identify the date of testing.

3.4 CLEANING

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.2 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 flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
 - .3 Test and Evaluation Reports:
-

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - UNINSULATED

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

2.3 NON-METALLIC - INSULATED

- .1 Type 4: non-collapsible, coated mineral base fabric or aluminum foil/mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

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 flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 DUCT INSTALLATION

- .1 Install in accordance with: UL 181.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCES

- .1 AMCA 99, Standards Handbook.
- .2 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
- .3 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-2007/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide:
 - .1 Fan performance curves showing point of operation, BHP, kW and efficiency.
 - .2 Sound rating data at point of operation.
- .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Procedures.

1.4 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Procedures.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
-

- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

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.

PART 2 - PRODUCTS

2.1 FANS GENERAL

- .1 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, and sound power data as indicated on schedule.
 - .2 Fans: statically and dynamically balanced, constructed in conformance with AMCA 99.
 - .3 Sound ratings: comply with AMCA 301-06, tested to AMCA 300-08. Unit shall bear AMCA certified sound rating seal.
 - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210-07, and ANSI/ASHRAE 51-2007/AMCA 210-07. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
 - .5 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers where specified.
 - .3 Sizes as indicated.
-

- .4 Two speed with two windings and speeds as indicated.
- .5 Two speed with split winding, constant horsepower constant or variable torque and speeds of r/min as indicated.
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment. Inlet outlet dampers and vanes and as indicated.
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Provide scroll casing drains.
- .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .10 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .11 Flexible connections: to Section 23 33 00 - Air Duct Accessories.
- .12 Complete with disconnect.

2.2 CEILING CABINET DISCHARGE FANS

- .1 Centrifugal forward curved wheel, direct drive, suitable for ceiling installation, zinc coated rectangular metal housing.
- .2 Size and capacity: as indicated.
- .3 Occupancy sensor timer or reverse-acting thermostat operated as indicated.
- .4 Plug type disconnect, thermal overload protection and adjustable mounting brackets.
- .5 Round or rectangular duct collar outlet with integral backdraft damper.
- .6 White polymeric designer grille.
- .7 CSA approval and UL/cUL listed.
- .8 Acceptable Material: Greenheck, Cook, Penn Barry.

2.3 IN-LINE CENTRIFUGAL FANS

- .1 Fan wheels: Characteristics and construction:
 - .1 Welded aluminum construction.
 - .2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.
 - .3 Forward curved blades.
- .2 Provide AMCS arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.
- .3 Bearings: split pillow-block flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated L₁₀ life of 40,000 hours.
- .4 Housing:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide bolted airtight access doors with handles.

PART 3 - EXECUTION

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings and seismic controls as specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
 - .2 Provide sheaves and belts required for final air balance.
 - .3 Bearings and extension tubes to be easily accessible.
 - .4 Access doors and access panels to be easily accessible.
 - .5 Size anchor bolts to withstand seismic acceleration and velocity forces.
 - .6 Arrange connecting duct work to follow manufacturer's recommendation regarding proper air flow patterns entering and exiting unit to avoid system fan effects.
-

- .7 Provide duct reducers/increasers at fan outlets as required to match duct sizing as indicated. Provide rectangular to round duct transition for fans with rectangular/square outlets.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 AMCA Publication 201-02(R2011), Fans and Systems.
 - .2 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - .5 AMCA Publication 302-73(R2012), Application of Sone Ratings for Non-Ducted Air Moving Devices.
 - .6 AMCA Publication 303-79(R2012), Application of Sound Power Level Ratings for Fans.

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 domestic fans and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect domestic fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 FANS - GENERAL

- .1 Standard of rating:
 - .1 AMCA Publication 201 for fan application.
 - .2 AMCA Publication 302 for application of sone loudness ratings for non-ducted air moving devices.
 - .3 AMCA Publication 303 for application of sound power ratings for ducted air moving devices.
 - .4 Performance: to ANSI/AMCA Standard 210. Unit to bear ANSI/AMCA certified seal.
- .2 Sound level ratings to comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300 Unit to bear ANSI/AMCA certified sound rating seal.
- .3 Maximum loudness: 5 sones.

2.2 RANGE HOOD

- .1 Width: 760 mm.
- .2 Material: Colour to be determined.
- .3 airflow: 104 L/s @ 88 Pa.
- .4 Electrical: 120/1/60, 2.0 A.
- .5 Speed: 3 speed.
- .6 Flood lights.
- .7 Charcoal filters.

- .8 Sound level: 5 sones @ 104 L/s.
- .9 Dupont non-stick bottom cover.
- .10 outlet; 83 mm x 250 mm or 175 mm.
- .11 Heat sentry to automatically turn blower to high speed when excessive heat detected.

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 domestic fan installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Supply for installation by other divisions.
- .2 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

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

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
-

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 air terminal units for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

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

2.3 VARIABLE VOLUME BOXES

- .1 Pressure independent factory reset to air flow between minimum and maximum air volume.
- .2 Sizes, capacities, differential pressures and sound ratings: as indicated.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .4 Complete with:
 - .1 Operator and controller: as specified under Section 25 30 02.
- .5 Operator to be factory mounted and calibrated:
 - .1 Gauge taps for balancing with standard pressure gauge.
 - .2 Controller to have adjustable flow settings.
- .6 Casing: constructed of galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL 181 and NFPA 90A. Mount control components inside protective metal shroud.
- .7 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
-

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

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 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 diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.2 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as indicated.

2.3 MANUFACTURED UNITS

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

2.4 SUPPLY GRILLES AND REGISTERS

- .1 General: see schedule.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: see schedule.

2.6 DIFFUSERS

- .1 General: see schedule.
-

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 diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

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

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96-17, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM E 90-09, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.

1.3 TEST REPORTS

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90-09.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
-

1.5 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

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.

PART 2 - PRODUCTS

2.1 HOODED WALL CAP

- .1 Construction: aluminum cap with aluminum finish.
- .2 Material: extruded aluminum alloy.
- .3 Complete with aluminum insect screen and gravity damper.
- .4 Finish: Printable. Colour to match building siding. Submit colour swatch to Departmental Representative for selection and approval.

2.2 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
 - .2 Material: extruded aluminum alloy 6063-T5.
 - .3 Blade: Drainable pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
 - .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm 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 mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, primer coated anodized. Colour: to Departmental Representative approval.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 52.2-12, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 International Organization of Standardization (ISO)
 - .1 ISO 14644-1-99, Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC -S111-07, Standard Method of Fire Tests for Air Filter Units.
 - .2 ULC-S646-06, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.2 SUBMITTALS

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each after commissioning plus commissioning set.
-

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

- .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum same material as casing/hood, 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 each side and/or from upstream.
-

2.3 FIBROUS GLASS PANEL FILTERS

- .1 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .2 Performance: minimum average synthetic dust weight arrestance 70% to ANSI/ASHRAE 52.2 .
- .3 Fire rated: to ULC -S111.

2.4 CARTRIDGE TYPE FILTERS, 80-85% EFFICIENCY

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 80-85% to ANSI/ASHRAE 52.2.
- .5 Fire rated: to ULC -S111.

2.5 FILTER GAUGES - MANOMETER TYPE

- .1 Inclined acrylic tube.
- .2 Complete with levelling screws.
- .3 Range: 0 to 2 times initial pressure.

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 filter installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
-

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION 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 (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.2 No.46-13, Electric Air-Heaters.

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 duct heaters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit product data and include:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 Number of stages.
 - .4 Rating of stage: rating, voltage, phase.
 - .5 Heater element watt/density and maximum sheath temperature.
 - .6 Maximum discharge temperature.
 - .7 Unit support.
 - .8 Clearance from combustible materials.
 - .9 Internal components wiring diagrams.
 - .10 Minimum operating airflow.
 - .11 Pressure drop operating minimum airflow.

1.3 DELIVERY, STORAGE AND HANDLING

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

- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 DUCT HEATERS

- .1 Duct heater complete with adjustable temperature control.
 - .1 Coils: high grade nickel-chrome alloy, insulated from galvanized steel frame by floating ceramic bushings. Coil terminal pins to be stainless steel, insulated by non-rotating ceramic bushings.
 - .2 Flange type heater. Mounting flange shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.
 - .3 Heaters to be complete with fail safe, manual and automatic reset disc-type thermal cut-outs as required by CSA.
 - .4 Duct heater shall be complete with a built-in disconnect to switch power off at the unit.
 - .5 Duct heaters shall be complete with magnetic contactors, 24 volt transformer, airflow sensor, duct temperature sensor, wall-mounted thermostat, SCR control, load fuses, solid state relays, pilot lights and protective screens required to provide a consistent air temperature output.
 - .6 Cut-outs shall be shielded from accidental impact and shall de-energize the heater in case of insufficient airflow.
 - .7 Capacities and sizes as indicated on drawings.
- .2 Electrical:
 - .1 Duct heater rating: 25 kW, 575/3/60.

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 duct heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
-

3.2 INSTALLATION

- .1 Make power and control connections to CSA C22.2 No.46.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in presence of Departmental Representative.
 - .1 Provide test report and include copy with Operations and Maintenance Manuals.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
 - .1 ANSI/AHRI 430-10, Performance Rating of Central Station Air-Handling Units.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 Green Seal (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .2 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18.

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 insulation, filters, adhesives, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings: fan fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil; include performance data.

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 air handling equipment for incorporation into manual.
- .3 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB, EWB, OAT.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare sets of filters after commissioning plus commissioning set.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/AHRI 430 with AHRI seal.
- .3 Horizontal or vertical type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers bypass section heating coil, cooling coil, filter, mixing box.

2.2 CASINGS

- .1 Zinc coated, heavy gauge galvanized steel, baked enamel finish.
- .2 Access panes.
- .3 Insulated with foil facets cleanable, fire retardent glass fiber material.
- .4 Sealed insulated edges.
- .5 Electrical and refrigerant connections.

2.3 DRAIN PANS

- .1 Construction: composite.
- .2 Insulation: external foam type, minimum 13 mm thick.
- .3 Drain connection: in four positions.
- .4 Installation: double scoped, removable, cleanable drain pan.

2.4 FANS

- .1 Double inlet, double width, forward curve centrifugal type.
 - .2 Adjustable belt drive, permanently lubricated bearings.
 - .3 Motor with thermal overload protection, fan contactors, permanently lubricated bearings.
-

2.5 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan: to Section 23 33 00 - Air Duct Accessories.
- .2 Flexible spring for floor mounting.

2.6 VARIABLE VOLUME DEVICES

- .1 Variable speed drives.

2.7 FILTER BOX

- .1 Material to match casing. For flat or V type filter arrangement:
 - .1 Provide access to filter through side panels.
- .2 Provide blank-off plates and gaskets to prevent air bypass. Filter slide rack for 50 mm filters.
- .3 Filters: in accordance with Section 23 44 00 - HVAC Air Filtration.
 - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media to ANSI/ASHRAE 52.2, to be used on return air section of air handling unit.
 - .2 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ANSI/ASHRAE 52.2.

2.8 COILS

- .1 Ratings: AHRI certified.
 - .2 Construction:
 - .1 Casings: 1.5 mm thick galvanized sheet steel.
 - .1 Supports of galvanized steel channel double angle frames.
 - .2 Blank-off plates. Insulated sandwich construction.
 - .2 Direct expansion refrigerant coils:
 - .1 Serpentine type, Straight tube type arranged to prevent trapping of oil, draw through.
 - .1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits, TX valve, single circuit.
 - .2 Silver solder or braze joints in refrigerant tubing.
-

- .3 Evacuate and charge coil with nitrogen and seal before sending to site.
- .2 Tubes: copper.
- .3 Fins: lanced aluminum plate.
- .4 Headers: copper.
- .5 Pressure tests: to Canadian Refrigeration Code. Dehydrated. Sealed with nitrogen charge.
- .3 Electric heaters: to 23 55 01.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

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

3.3 FANS

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

3.4 DRIP PANS

- .1 Install deep seal P-traps and trap seal primer on drip lines.
-

.1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B52S1-09, Mechanical Refrigeration Code.
 - .2 CAN/CSA-C656-14, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
- .2 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 WARRANTY

- .1 For refrigeration compressors, refer to the terms of the General Conditions.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Integrated package: to CAN/CSA-C656.
 - .2 System type:
-

- .1 Heating and Cooling: direct expansion
- .2 Condensing: air cooled.
- .3 One indoor unit connected to one outdoor unit.
- .3 Unit rated performance based on, 24/18°C (DB/WB) ambient, 23/16°C (DB/WB) indoor for cooling; -18°C (DB) ambient, 21/12°C (DB/WB) indoor for heating.
- .4 Capacities: as indicated.
- .5 Refrigerant: R410A.

2.2 INDOOR UNIT

- .1 See Section 23 73 11.

2.3 CONDENSING UNIT

- .1 12.5 SEER (min) cooling, 2.7 COP (min) heating, certified ratings to AHRI standards, R410A refrigerant, front discharge.
 - .1 Vibration isolators, stand and mounting kit.
 - .2 Adjustable high and low pressure switches.
 - .3 Short cycle delay timer
 - .4 Motor overload and over temperature protection.
 - .5 Refrigerant service valves.
 - .6 Low ambient operation.
 - .7 Crankcase heater
 - .8 Electrical: 600 V/3 Ph/60 Hz single point power connection with disconnect switch.
 - .9 Single refrigeration circuit with integral subcooling coil.
 - .10 Direct drive hermetic scroll compressor.
 - .11 Suction gas cooled motor w/± 10% voltage utilization range.
 - .12 Reversing valve.
 - .13 Internal temperature and current sensor motor overloads.
 - .14 Liquid line filter dryer.
 - .15 Phase loss/reverse rotation monitor.
 - .16 Liquid and suction line service valves with gauge port.
 - .17 Evaporator defrost control.
 - .18 Loss of charge protection.
 - .19 Galvanize steel, heavy gauge casing, baked enamel finish, meets ASTM B117, 672 hour salt spray test.
 - .20 Removable side access panels.
 - .21 Nitrogen holding charge.
 - .22 Condenser coil 10 mm internally enhanced copper tube, mechanically bonded to lanced aluminum plate fins, epoxy coated.
-

.23 Condenser fans direct drive, propeller type, statically and dynamically balanced.

.24 Condenser motor permanently lubricated, totally enclosed, built in current and thermal overloads, ball or sleeve bearing type.

2.4 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT

.1 To Section 23 23 00 - Copper Tubing and Fittings - Refrigerant.

.2 To CSA B52.

.3 Include for each refrigerant circuit:

.1 Thermal expansion valve, external equalizing type.

.2 Combination filter-dryer.

.3 Solenoid valves.

.4 Liquid sight glass with moisture indicator.

2.5 REFRIGERANT CHARGE

.1 Charge refrigerant system as per Section 23 33 00.

2.6 CONTROLS

.1 Centralized microprocessor.

.2 Indoor and outdoor temperature sensors drive algorithms, making decisions for all heating, cooling and ventilation.

.3 Integrated anti-short cycle timer.

.4 Integrated time delay between compressor.

.5 Completely internally wired, numbered and coloured wires.

.6 Single point entry.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install as indicated, to manufacturer's recommendations, and in accordance with EPS 1/RA/2.

- .2 Manufacturer to certify installation.
- .3 Power and control wiring for evaporator units by
Air-conditioner subcontractor.
- .4 Provide access panels/doors for maintenance and servicing.

PART 1 - GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.46, Electric Air-Heaters.
- .2 Underwriters' Laboratories (UL)
 - .1 UL 1042, Standard for Electric Baseboard Heating Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for baseboard convectors, include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and Finish.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
-

PART 2 - PRODUCTS

2.1 CAPACITY

- .1 To match existing or as indicated.

2.2 BASEBOARD CONVECTORS

- .1 Heaters: to CSA C22.2 No.46 UL 1042 low standard high wattage density with connection box one both ends.
 - .1 Element through-type fitted with aluminum steel, zinc plated convector vanes and resistor wire enclosed in mineral insulation in copper aluminum sheath.
- .2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.
- .3 Cabinet: to CSA C22.2 No.46 UL 1042, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom and built-in clamps.
 - .1 Bottom inlet/top outlet.
 - .2 Panel: steel metal thickness, bottom 1.6 mm thick.
 - .3 Finish: phosphatized and finished with coats air-dry baked enamel, white colour.
 - .4 Electrical Characteristics:
 - .1 240V, 1 Ph.
 - .2 Capacity as indicated.
- .4 Acceptable Material:
 - .1 Ouellet.
 - .2 Dimplex.
 - .3 Chromalox.
 - .4 Stelpro.

2.3 CONTROLS

- .1 By Division 25.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install baseboard convector heaters, blank sections and controls.
-

- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity.
- .4 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.

3.3 PROTECTION

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.46-13, Electric Air-Heaters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-14, Enclosures for Electrical Equipment (1000 V Maximum).

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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

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 unit heaters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect unit heaters from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection.
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as specified.
- .5 Elements: mineral insulated steel stainless steel sheath with aluminum, single continuous helical brazed fins.
- .6 Cabinet: steel, 12 mm thick, fitted with brackets for rod or wall mounting.
 - .1 Phosphatized and finished with two coats baked enamel in Departmental Representative approved colour.
- .7 Integral disconnect switch.
- .8 Electrical Characteristics:
 - .1 240V, 1 Ph.
 - .2 Capacity as indicated.

2.2 CONTROLS

- .1 By Division 25.
-

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 unit heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in indicated locations.
- .3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
-

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

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

PART 1 - GENERAL

1.1 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 fulfil 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.

1.2 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.

1.3 ACTION AND INFORMATIONAL 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.

1.4 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 and Section 25 05 03 - EMCS: Project Record Documents.

1.5 COMMISSIONING

- .1 Carry out commissioning under direction of Departmental Representative and Commissioning Authority.
 - .2 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.
 - .3 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
 - .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
 - .5 Load system with project software.
 - .6 Perform tests as required.
-

1.6 COMPLETION OF COMMISSIONING

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

1.7 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 Authority and/or Departmental Representative.
 - .3 Commission integrated systems using procedures prescribed by Commissioning Authority and/or Departmental Representative.
 - .4 Debug system software.
-

- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Program CDL changes as requested by Departmental Representative.
- .7 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .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 Configure major components to be tested in same architecture as designed system. Include all required network and control components.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp metre at source.
 - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
 - .8 Departmental Representative to mark instruments tracking within 0.5 % in both directions as "approved for installation".
 - .9 Transmitters above 0.5% error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
 - .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
-

- .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. This document will be used in final startup testing.
 - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and Commissioning Authority and provide:
 - .1 Technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
 - .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
-

- .2 Test to last at least 30 consecutive 24 hour days.
- .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
- .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Authority and/or Departmental Representative to verify reported results.

3.3 ADJUSTING

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

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Coordinator and/or Departmental Representative operation in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.3 QUALITY ASSURANCE

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

1.4 INSTRUCTIONS

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

1.5 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.6 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.7 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
 - .2 Phase 1: 3 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative and PSPC Commissioning Manager.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
 - .5 Introduction to Direct Digital Controls and BACnet protocol.
 - .6 Identification of Control Components.
 - .7 Review of DDC Network Diagram for building.
 - .8 Review of shop drawings for building.
 - .9 Detailed discussion of sequences of operation.
 - .10 Walk through of mechanical systems.
 - .11 Allow three (3) days for Phase 1 training.
 - .3 Phase 2: program to begin 8 weeks after acceptance by Departmental Representative of successful 30 day tests:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
-

.2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with 2 days training within 5 day period in following subjects:

- .1 Software and architecture.
- .2 Application programs.
- .3 Controller programming.
- .4 Trouble shooting and debugging.
- .5 Colour graphic generation.
- .6 Display and interpret summaries.
- .7 Compound points.
- .8 Modify points and point groups.
- .9 Define trend logs.
- .10 Schedule and print reports.
- .11 Allow two (2) days for Phase 2 training.

1.8 ADDITIONAL TRAINING

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

1.9 MONITORING OF TRAINING

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

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.1, Canadian Electrical Code, Part II, Section 0 (General Requirements).
 - .2 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .4 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B, Control Network Protocol Specification.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 ABBREVIATIONS AND ACRONYMS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level
 - .2 AI - Analog Input
 - .3 AO - Analog Output
 - .4 BACnet - Building Automation and Control Network.
 - .5 BC(s) - Building Controller(s).
 - .6 CAB - Canadian Automated Building (CAB) Protocol.
 - .7 CAD - Computer Aided Design.
 - .8 CDL - Control Description Logic.
 - .9 CDS - Control Design Schematic.
 - .10 COSV - Change of State or Value.
 - .11 CPU - Central Processing Unit.
 - .12 DI - Digital Input.
-

- .13 DO - Digital Output.
- .14 DP - Differential Pressure.
- .15 ECU - Equipment Control Unit.
- .16 EMCS - Energy Monitoring and Control System.
- .17 HVAC - Heating, Ventilation, Air Conditioning.
- .18 IDE - Interface Device Equipment.
- .19 I/O - Input/Output.
- .20 ISA - Industry Standard Architecture.
- .21 LAN - Local Area Network.
- .22 LCU - Local Control Unit.
- .23 Lon-Talk - Echelon Corporation (proprietary protocol).
- .24 MCU - Master Control Unit.
- .25 NC - Normally Closed.
- .26 NCU - Network Control Unit
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PCU - Programmable Control Unit.
- .35 PID - Proportional, Integral and Derivative.
- .36 RAM - Random Access Memory.
- .37 SP - Static Pressure.
- .38 ROM - Read Only Memory.
- .39 TCU - Terminal Control Unit.
- .40 USB - Universal Serial Bus.
- .41 UPS - Uninterruptible Power Supply.
- .42 VAV - Variable Air Volume.

1.3 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
 - .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
-

- .1 Area descriptor: building or part of building where point is located.
- .2 System descriptor: system that point is located on.
- .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
- .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.4 SYSTEM DESCRIPTION

- .1 Refer to control schematics, sequences of operation and related Divisions of specification for system architecture.
 - .2 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall not in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller or group of dedicated controllers within a mechanical room to have a locally mounted control and display device to allow the operator to view and adjust any point on an individual controller or group of controllers if such controllers are located within a mechanical room.
 - .3 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Programmable Controllers LUC, Expandable LCUs, TCU.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
-

- .4 Data communications equipment necessary to effect EMCS data transmission system including gateway and LAN hardware and software for connection to LAN network.
 - .5 All field control devices.
 - .6 All wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts AC by Division 26.
 - .7 Software/Hardware complete with full documentation.
 - .8 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.
 - .9 Training of personnel.
 - .10 Acceptance tests, technical support during commissioning, full documentation.
 - .11 Wiring interface co-ordination of equipment supplied by others.
 - .12 Miscellaneous work as specified in these sections and as indicated.
 - .13 Integration of liquid-cooled chillers.
- .4 BACnet compliance: full compliance to the BACnet standard (ANSA/ASHRAE) 135, BACnet - A Data communication Protocol for Building Automation and Control Networks is mandatory. Down to the field device level, the EMCS system must meet BACnet standards for system architecture and administration, and use open communication protocols and user friendly programming and graphics. Install the EMCS installed to communicate at the supervisory layer using the BACnet IP protocol implemented on Ethernet.
- .5 The EMCS system for this facility to be accessible by designated personnel via the WAN for monitoring and programming purposes. The EMCS contractor to provide all the required hardware, software, gateways, etc. needed to permit connection of the EMCS to the WAN. This shall include all hardware, software, programming, start-up and commissioning required. The contractor to supply and install all the required hardware and software on the WAN file server to allow for this remote operation monitoring and programming to take place. The contractor to supply and install all the required hardware and software on the operator workstation(s) located in the Owner's facilities management department. In addition, a remote dial in access directly to the system shall be provided.

1.5 METRIC REFERENCES

- .1 Conform to CAN/CSA Z234.1.
-

- .2 Provide required adapters between Metric and Imperial components.

1.6 STANDARDS COMPLIANCE

- .1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
- .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by third party Engineer registered in Canada certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/codes/ specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
- .6 BACnet devices to bear BACnet testing laboratories BTL mark and listed on BACnet manufacturers association web site .

1.7 EMCS CONTRACTOR QUALIFICATIONS

- .1 EMCS contractor to:
 - .1 Have local office staffed by trained personnel capable of providing instruction, routine maintenance, emergency service on systems to Departmental Representative for review. on systems to Departmental Representative for review.
 - .2 Provide record of successful similar installations performed by Contractor. Provide ten (10) days after tender closing.
 - .3 Have access to supplies of essential parts.
 - .4 Be able to provide trained personnel on site within 24 hours notice or provide instructions on maintenance and emergency service on system.
-

1.8 SYSTEM DESIGN RESPONSIBILITY

- .1 Design and provide conduit and wiring at 50 volts AC or less linking all elements of system, including future capability.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents to be approved by Departmental Representative prior to installation.
- .3 Location of controllers to be approved Departmental Representative prior to installation.
- .4 Provide uninterruptible power supply to OWS.

1.9 LANGUAGE OPERATING REQUIREMENTS

- .1 Operator to interface to system in English through operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface (specified as part of hardware purchase) with associated documentation to be in English.
 - .4 System manager software: to include system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency. These functions to be in English.
 - .5 EMCS operator: include, in English:
 - .1 All input and output commands and messages from operator-initiated functions and/or field related changes and/or alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS. Point name expansions in English.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.
-

1.10 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Quality Control:
 - .1 Permits and fees: in accordance with general conditions of contract.

1.11 QUALITY ASSURANCE

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

1.12 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.13 EXISTING- CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
 - .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
 - .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
-

- .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SYSTEMS, MANUFACTURERS

- .1 Alerton, Delta, Automated Logic, Honeywell, Johnson Controls, Invensys, or approved substitute.

2.2 GENERAL

- .1 Proposed system to have communication capability utilizing BACnet Protocol.
 - .2 Control panels to be NEMA rated to suit environmental requirements.
 - .3 Control panels to have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.
 - .4 Wiring within panels to be contained within properly sized rigid PVC slotted wall wire duct. All wiring within the wire duct to be concealed with a non-slip cover.
-

- .5 Terminations for the connection of power wiring, communication wiring and field mounted devices to be at properly identified terminal blocks mounted within the control panel.
- .6 All control panels to be provided with an internally mounted 120 volt duplex power receptacle. The supply and installation of this receptacle shall be the responsibility of the Division 26 Electrical Contractor.
- .7 All control panels to be identified with permanently mounted Lamecoid tags to identify the control panel and the systems served by the control panel. Submit schedule of labels with shop drawing submission.
- .8 Provide low voltage transformers in panels or elsewhere as required.
- .9 All tubs housing controllers to have a display device to allow the operator to view and adjust any point on any controller within the control tub. This display device to be mounted in the face of the hinged front cover of the control tub.
- .10 Display devices to be mounted 1500 mm AFF.
- .11 Provide RJ-45 system network connection in side of each control tub so it is not necessary to open the control tub front door to connect an external device such as a laptop computer to the control system Ethernet network.
- .12 The EMCS Contractor shall be responsible to fabricate and install plywood shelves with steel support frames directly adjacent to each control tub to enable temporary placement of a laptop computer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations. Provide printed copies of recommendations with shop drawings or product data.

3.2 PAINTING

- .1 Painting: supplemented as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
-

- .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .4 Paint unfinished equipment installed indoors.

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Description and location of installing and servicing technical staff.
 - .2 Qualifications of programming design and programming support staff.
 - .3 Names of sub-contractors and site-specific key personnel.
 - .4 Sketch of site-specific system architecture.
 - .5 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .6 Descriptive brochures.
 - .7 Sample CDL and graphics (systems schematics).
 - .8 Item by item statement of compliance with all EMCS specification sections.
 - .9 Proof of demonstrated ability of system to communicate utilizing BACnet protocol.
 - .10 Controller locations.
 - .11 Auxiliary control cabinet locations.
 - .12 Spare point capacity of each controller by number and type.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 All references to submittals below shall mean the responsibility of the Contractor unless otherwise noted.
 - .2 The Contractor shall be responsible to submit shop drawings of all field devices shown on the drawings to the Departmental Representative for review and approval.
 - .3 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
 - .4 Submit to be a completely indexed and coordinated package to assure compliance with contract requirements, and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
-

- .5 Submittals shall consist of:
 - .1 Data sheets of all products.
 - .2 Wiring interconnection diagrams including panel and device power, and sources.
 - .3 List of materials of all proposed devices and equipment.
 - .4 Software documentation.
 - .5 Sequence of operation, in text form.
 - .6 Application programs.
 - .7 Point Schedules.
 - .8 Controls schematics and system diagrams.
 - .9 network architecture.
 - .10 IP address for the OWS (obtain from Owner's IT personnel).
 - .11 Names of subtrades working for EMCS contactor.
 - .12 Mounting support details for components installed in airflow, waterflow and steam systems.
 - .6 Submit shop drawings in a package which contains the various schedules and drawings which completely describe the control system installed. At a minimum the shop drawing package to contain the following items described in Items .7 to .27 as follows.
 - .7 Network drawing showing the network connection of all network control units, programmable control units, terminal control units and operator workstations to indicate the location of each of these elements. The network drawing shall show the IP address of the OWS.
 - .8 Schematic control diagram for each system being controlled. Where there are typical systems a drawing to be provided for each system. This drawing to be on a AB size sheet (11 x 17) and shall include a title block which includes as a minimum the drawing title, drawing number, project title, contractor's name, contractor's address, contractor's phone and fax numbers, contractor's project number and a section to provide a record for revision information.
 - .9 The schematic control diagram to include a bill of materials which provides a list of all part numbers and descriptions for the control components on the drawing list to include field equipment as well as panel mounted components.
 - .10 The schematic control diagram to include a complete wiring diagram for all electrical connections, including motor starters, heating coils, coil coils etc.
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- .11 The schematic control diagram to include a layout of the control panels for each system. This layout to show the mounting of all panel equipment, including transformers, power supplies, controllers, transducers, sensors, relays, contactors and any other panel mounted equipment.
 - .12 The contractor to include with the shop drawing submittal drawings, showing all wiring details for the connections of sensors, transducers, relays and contactors these details to show terminal numbers and be referenced to the appropriate schedules and drawings.
 - .13 The contractor to supply with the shop drawing package a complete point schedule to show every point connected to the system. This schedule to be in tabular format and provide the point identification, point type, wire tag, termination details reference, referenced drawings, device mounting location and device code numbers.
 - .14 The point schedule to provide at a minimum the following information in the software attributes of the point:
 - .1 Tag name - ex. EPT-1.
 - .2 Point type - ex. AO-3.
 - .3 System name - ex. A/C-1.
 - .4 Object name - H-VLV.
 - .5 Expanded ID - Heating control valve.
 - .6 Units of measurement - %.
 - .15 The point schedule to provide at a minimum the following information on the digital controller to which the point is connected.
 - .1 Controller type - ex. Unitary controller.
 - .2 Controller address - ex. 256.
 - .3 Cable destination - the termination at the controller, ex. AO-1.
 - .4 Terminal numbers - the termination at the controller.
 - .16 The point schedule to provide at minimum the following information on the control panel.
 - .1 Panel identification.
 - .2 Panel location.
 - .3 Reference drawing.
 - .17 The point schedule to provide at a minimum the following information on any intermediate device which may be associated with the point.
 - .1 Type of wiring or tubing used.
 - .2 Device part number.
 - .3 Location of the device.
 - .4 Reference details.
-

- .18 The point schedule to provide at a minimum the following information on any field device which may be associated with the point.
 - .1 Type of wiring or tubing used.
 - .2 Device part number.
 - .3 Location of the devices.
 - .4 Reference details.
 - .19 The contractor to supply with the shop drawing package a complete room schedule, to show the equipment associated with the room controls. Schedule to be in tabular format and provide the room number and location, terminal unit number, part numbers for the terminal unit controller, sensors and actuators. Included on this schedule terminal unit type, size, minimum flow and maximum flow.
 - .20 Sequence of operation for each system controlled. Sequence to be in complete conformance with the sequence of operations included with this specification. Any changes require the approval of the Engineer in writing. Sequence to include all modes of operation including fail safe, emergency and fire modes.
 - .21 Valve schedule including design flow, CV, size, type, actuator, pressure drop and maximum shut off pressure differential for each control valve.
 - .22 Damper schedule including design air flow, size, type actuator and torque requirements for each control damper.
 - .23 Provide one permanent, not fading, as built copy of each control drawing, enclosed by an aluminum frame with glass cover, or sealed by plastic laminate in rigid metal bound frame. To be installed at each respective control panel location.
 - .24 Catalogue cut sheets of all equipment used. This includes, but is not limited to DDC panels, peripherals, sensors, actuators, dampers, control air system components, etc.
 - .25 Range and scale information for all transmitters and sensors. This sheet to clearly indicate one device and any applicable options. Where more than one device to be used is on a single sheet, submit two sheets, individually marked.
 - .26 Hardware data sheets for all operator workstations and local operator terminals.
-

- .27 Software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices.

1.4 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
 - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

1.5 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 90 working days after award of contract and before start of installation. Detailed shop drawings shall be as described in Item 1.4 of this specification section. In addition provide the following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
-

- .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
- .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Pneumatic schematics and schedules .
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Listing of all points being monitored and alarmed.
- .12 Listing of all points being trended.
- .13 Sample of "Operating Instructions Manual" to be used for training purposes.
- .14 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.6 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between Contract Document requirements and actual items (e.g.: points list inconsistencies).
-

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Owner.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

PART 1 - GENERAL

1.1 DEFINITIONS

- .1 OWS - Operator Work Station.
- .2 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents As-built drawings Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.3 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to Contract Documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
-

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

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

1.4 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide four (4) hard and one (1) soft copy of O&M Manuals to Departmental Representative prior to system or equipment tests.

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

- .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.
-

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

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

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

PART 2 - PRODUCTS

2.1 NAMEPLATES FOR PANELS

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

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

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

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.
- .3 If panel has no clear space for label, mount adjacent to panel.
- .4 Size: 25 mm x 125 mm.
- .5 Lettering height: 8 mm.

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
 - .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
-

- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint.

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.

3.2 EXISTING PANELS

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
 - .2 ANSI C2, National Electrical Safety Code.
 - .3 ANSI/NFPA 70-, National Electrical Code.
- .2 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1.
 - .2 CAN/CSA-C22.3 No. 1, Overhead Systems.
 - .3 CSA C22.3 No. 7, Underground Systems.

1.2 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 120V power wiring to EMCS field panels shall be the responsibility of the Electrical Contractor (Div 26). Circuits to be for exclusive use of EMCS: Equipment.
 - .2 Hard wiring between field control devices and EMCS field panels below 50V shall be the responsibility of the EMCS Contractor (Div 25).
 - .3 Hard wiring between field control devices and EMCS field panels 50V and above shall be the responsibility of the Electrical Contractor (Div 26).
 - .4 All network wiring shall be the responsibility of the EMCS Contractor (Div 25).
 - .2 Mechanical:
 - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Mechanical Division.
 - .2 Thermowells shall be supplied by the EMCS Contractor and installed by the Mechanical Contractor.
 - .3 Control valves shall be supplied by the EMCS Contractor and installed by the Mechanical Contractor.
 - .4 Pipe mounted flow meters including hardware installation kit shall be supplied by the EMCS Contractor. The flow meter hardware installation kit shall be installed by the Mechanical Contractor. The actual flow meter shall be installed and properly height adjusted by the EMCS Contractor.
 - .5 Duct mounted airflow measuring station probes shall be supplied by the EMCS Contractor and installed by the Mechanical Contractor under the direction of the EMCS Contractor.
 - .6 Duct mounted devices, such as temperature sensors, humidity sensors, duct probes, etc., shall be supplied and installed by the EMCS Contractor.
-

.7 Cutting of holes in ductwork to facilitate installation of duct mounted control devices shall be carried out by the Mechanical Contractor (Div 23) under the direction of the EMCS Contractor.

.8 All control valve and damper actuators (with the exception of the face and bypass dampers in ERV-1 and ERV-2) shall be supplied and installed by the EMCS Contractor.

.9 All operable dampers shall be supplied and installed by the Mechanical Contractor (Div 23).

.10 Cutting of holes in air handling unit casing to enable installation of control devices shall be the responsibility of the Mechanical Contractor (Div 23) under the direction of the EMCS Contractor.

.11 Installation of control devices on and inside of air handling units, such as averaging temperature sensors, low limits, etc., shall be the responsibility of the EMCS Contractor

.3 VAV Terminal Units.

.1 Air flow probe for VAV boxes to be supplied and installed under Mechanical Division. Air flow dp sensor, actuator and associated VAV controls to be supplied and installed by EMCS Contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS Contractor. Coordinate air flow adjustments with balancing trade.

.4 Structural:

.1 Special steelwork as required for installation of work.

1.3 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

- .1 Continuously direct and monitor all work.
- .2 Attend site meetings.

1.4 EXISTING CONDITIONS

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

PART 2 - PRODUCTS

2.1 PIPING

- .1 Sanitary, storm water: refer to Section 22 13 17 - Drainage Waste, Vent Piping - Cast Iron and Copper.
- .2 Refrigeration: refer to Section 23 23 00 - Refrigerant Piping.
- .3 Sleeves, escutcheons: refer to Section 23 05 05 - Installation of Pipework.
- .4 Hangers and supports: refer to Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.
- .5 Insulation: refer to Section 23 07 13 - Thermal Insulation For Ducting.

2.2 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.
- .2 Galvanized unistrut shall be considered as an acceptable alternative to the steel support outlined above where applicable.

2.3 WIRING

- .1 As per requirements of Division 26.
 - .2 For 50V and above shall be the responsibility of the Electrical Contractor (Div 26). Wiring under 50V shall be the responsibility of the EMCS Contractor (Div 25).
 - .3 For wiring under 50 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring. All wiring shall be run in conduit unless otherwise noted.
 - .4 Sizes:
 - .1 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .2 Field wiring to digital device: #18 AWG or 20 AWG stranded twisted pair.
 - .3 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.
-

.4 More than 4 conductors: #22 minimum solid copper.
.5 See Section 25 10 01 - EMCS: Local Area Network (LAN) for details of wiring associated with EMCS communication networks, which is the responsibility of the EMCS Contractor.

.5 Terminations:

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.4 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 03. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56.
- .3 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.5 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.

2.6 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
 - .2 Exposed conduits or cables:
-

- .1 50 mm diameter and smaller: one-hole steel straps.
- .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 PIPING

- .1 Sanitary, storm water: refer to Section 22 13 17 - Drainage Waste and Vent Piping - Cast Iron and Copper.
- .2 Refrigeration: refer to Section 23 23 00 - Copper tubing and fittings Refrigerant.
- .3 Insulation: refer to Section 23 05 05 - Installation of Pipework.

3.3 MECHANICAL PIPING

- .1 Install piping in accordance with Section 23 05 05 - Installation of Pipework.

3.4 SUPPORTS

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

3.5 ELECTRICAL GENERAL

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

- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 50 V) contacts and mark to prevent accidental injury.
- .3 Conform to manufacturer's recommendations for storage, handling and installation.
- .4 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .5 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .6 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .7 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .8 Install conduits, and sleeves prior to pouring of concrete.
- .9 Holes through exterior wall and roofs: flash and make weatherproof.
- .10 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes. Drilling of the holes shall be the responsibility of the General Contractor.
- .11 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.6 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
 - .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
-

- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
 - .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
 - .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
 - .6 Limit conduit length between pull boxes to less than 30 m.
 - .7 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
 - .8 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
 - .9 Install polypropylene fish cord in empty conduits for future use.
 - .10 Where conduits become blocked, remove and replace blocked sections.
 - .11 Pass conduits through structural members only after receipt of Departmental Representative's DCC Representative's Consultant's written approval.
 - .12 Conduits may be run in flanged portion of structural steel.
 - .13 Group conduits wherever possible on suspended or surface channels.
 - .14 Pull boxes:
 - .1 Install in inconspicuous but accessible locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
-

- .4 Provide correct size of openings. Reducing washers not permitted.
- .5 Mark location of pull boxes on record drawings.
- .15 Install terminal blocks or strips indicated in cabinets to Division 26.

3.7 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.

3.8 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
 - .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.
-

3.9 STARTERS, CONTROL DEVICES

- .1 Manual motor starters, magnetic motor starters, combination magnetic motor starters, fused disconnects, non-fused disconnects, reduced voltage starters shall be supplied, installed and wired by the Division 26 Electrical Contractor unless otherwise noted.
- .2 Variable frequency drives (VFDs) shall be supplied by the Electrical Contractor (Division 26) and installed by the EMCS Contractor, except for VFDs serving the chiller, which will be supplied and installed by the chiller manufacturer.
- .3 Make control connections as indicated.
- .4 Ensure correct over-current devices are installed.
- .5 Identify each control wire, terminal for external connections with permanent number marking identical to diagram.
- .6 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.10 GROUNDING

- .1 Install ground wire in all PVC ducts and in tunnel conduit systems.

3.11 IDENTIFICATION

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

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204, Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 OWS - Operator Work Station.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
 - .3 Submit detailed inspection reports to Departmental Representative.
 - .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required.
 - .7 Other action taken or recommended.
 - .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
 - .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Maintain records and logs of each maintenance task on site.
-

- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
 - .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
 - .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
 - .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
 - .5 Provide system modifications in writing.
-

.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.5 SERVICE CONTRACTS

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
 - .1 Annual verification of field points for operation and calibration.
 - .2 visits per year.
 - .3 responses to emergency calls during day, per year.
 - .4 responses to emergency calls during silent hours per year.
 - .5 Silent hours defined as.
 - .6 Complete inventory of installed system.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
 - .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
 - .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
-

- .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Operations Supervisor and/or Departmental Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required (as per 3.1.3.2).
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International).
 - .1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
 - .2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
 - .1 IEEE Std 802.3TM, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
 - .2 TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
 - .1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529 TIA/EIA-568 and CSA T530 TIA/EIA-569-A and TBITS 6.9.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
 - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
-

- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Modems.
 - .3 Network interface cards.
 - .4 Network management hardware and software.
 - .5 Network components necessary for complete network.

1.4 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 High speed, high performance, local area network over which MCUs and OWSSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .2 EMCS-LAN to: BACnet, Proprietary Protocol.
 - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .4 Support of combination of MCUs and OWSSs directly connected to EMCS-LAN.
 - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .6 Detection and accommodation of single or multiple failures of either OWSSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
 - .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
 - .3 Network Medium.
 - .1 Network medium: twisted cable, shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.
-

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

PART 1 - GENERAL

1.1 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.2 OWS SYSTEM DESCRIPTION

- .1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.
- .2 OWS to include:
 - .1 Laser printer.
 - .2 Modem.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 ENVIRONMENTAL CONDITIONS

- .1 OWS to operate in conditions of 10°C to 32°C and 20 % to 90 % non-condensing RH.

1.5 MAINTENANCE

- .1 In accordance with Section 25 08 20 - EMCS: Warranty and Maintenance and Section 25 05 03 - EMCS: Project Record Documents.

PART 2 - PRODUCTS

2.1 OWS HARDWARE

- .1 PC system to include:
-

- .1 Processor as specified herein, capable of supporting software necessary to perform functions specified in this section.
 - .2 Internal clock.
 - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
 - .2 Rechargeable batteries: to provide minimum 48 hours clock operation in event of power failure.
 - .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
-
- .2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.
 - .3 Include 600 VA UPS to provide 30 minutes minimum operation of PC, CRT and communication and peripheral devices.

2.2 OWS PC COMPONENTS

- .1 Primary OWS: IBM PC compatible with following as minimum:
 - .1 MS Windows 7 Professional (32-bit).
 - .2 1 gigahertz (GHz) or faster.
 - .3 4 gigabyte (GB) RAM.
 - .4 80 GB available hard disk space.
 - .5 DirectX 9 graphics device with WDDM 1.0 or higher driver.
 - .6 Flat panel 19" monitor (minimum).
 - .7 16X dVD+/-RW Drive.
 - .8 10/100/1000 Ethernet network controller.
 - .9 USB mouse and keyboard.

2.3 PRINTERS

- .1 Report/Graphics printer: to include following features:
 - .1 Laser printer.

2.4 CONTROL DESK CONSOLE

- .1 Capable of accommodating OWS and peripheral equipment specified with provision for operator desk work space.
 - .2 Layout: as approval of Departmental Representative.
 - .3 Desk: steel office type, standard sizes 1 m x 2 m, factory-made, computer type, for equipment mounting, with drawers on one side.
-

- .1 Keyboards to be in separate pull-out drawer.
- .2 Include above desk shelving to support contractor supplied manuals.
- .4 Chair: upholstered, swivel type, with adjustable arms, back and seat, pneumatic seat height adjustment and 5 castors.

2.5 OPERATING SYSTEM (OS) OR EXECUTIVE

- .1 OS to support complement of hardware terminals and software programs specified.
- .2 OS to be true multitasking operating environment.
 - .1 MS DOS or PC DOS based software platforms not permitted.
- .3 OWS software to operate in "Windows" based operating environment: OS to be Microsoft Windows 7 Professional.

2.6 OWS CONTROL SOFTWARE

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
 - .2 OWS Software to consist of the following functional modules as minimum:
 - .1 Time Synchronization: Module.
 - .2 User Display Interface Module.
 - .3 General Event Log Module.
 - .4 Operator Control Software Module.
 - .5 Dial-up Host Module.
 - .6 Message Handling: Module.
 - .7 Access Control Module.
 - .8 Trend Data Module.
 - .9 Report Generator Module.
 - .10 Graphics Display Module.
 - .11 Event/Alarm Module.
 - .12 Archiving and Restoration Module.
 - .13 CDL Generator and Modifier Module.
 - .3 Time Synchronization Module.
 - .1 System to provide Time Synchronization of real-time clocks in controllers panel.
 - .2 System to perform this feature on regular scheduled basis and on operator request.
-

- .4 User Display Interface Module.
 - .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
 - .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.
 - .5 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
 - .1 Operator Log-in from user interface device.
 - .2 Communication messages: errors, failures and recovery.
 - .3 Event notifications and alarms by category.
 - .4 Record of operator initiated commands.
 - .6 General Event Log:
 - .1 Hold minimum of 4 months information and be readily accessible to operator.
 - .2 Able to be archived as necessary to prevent loss of information.
 - .7 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
 - .1 Automatic logging of digital alarms and change of status messages.
 - .2 Automatic logging of analog alarms.
 - .3 System changes: alarm limits, set-points, alarm lockouts.
 - .4 Display specific point values, states as selected.
 - .5 Provide reports as requested and on scheduled basis when required.
 - .6 Display graphics as requested, and on alarm receptions (user's option).
 - .7 Display list of points within system.
 - .8 Display list of systems within building.
 - .9 Direct output of information to selected peripheral device.
-

- .10 On-line changes:
 - .1 Alarm limits.
 - .2 Setpoints.
 - .3 Deadbands.
 - .4 Control and change of state changes.
 - .5 Time, day, month, year.
 - .6 Control loop configuration changes for controller-based CDLs.
 - .7 Control loop tuning changes.
 - .8 Schedule changes.
 - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
 - .11 According to assigned user privileges (password definition) following functions are to be supported:
 - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
 - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
 - .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
-
- .8 Dial-up host Module for off site OWSs.
 - .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
 - .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.
 - .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
 - .4 Communications taking place with remote control systems or OWS over telephone lines to be completely transparent to operator, both local and remote.
-
- .9 Message Handling Module - and Error Messages: to provide message handling for following conditions:
 - .1 Message and alarm buffering to prevent loss of information.
 - .2 Error detection correction and retransmission to guarantee data integrity.
-

.3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.

.4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event that OWS does not respond.

.10 Access Control Module.

.1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:

- .1 Guest: no password data access and display only.
- .2 Operator Level: full operational commands including automatic override.
- .3 Technician: data base modifications.
- .4 Programmer: data base generation.
- .5 Highest Level: system administration - password assignment addition, modification.

.2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.

.11 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.

.1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.

.2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 hours basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.

.3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.

.4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.

.5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.

.12 Report Module:

.1 General: The OWS to include special reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at the expandable LCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.

.2 Reports to include time, day, month, year, report title, operator's initials.

.3 Software to provide capability to:

- .1 Generate and format reports for graphical and numerical display from real time and stored data.
- .2 Print and store reports as selected by operator.
- .3 Select and assign points used in such reports.
- .4 Sort output by area, system, as minimum.

.4 Periodic/automatic report:

.1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.

.2 Reports to include:

- .1 Power demand and duty cycle summary: see application program for same.
-

- .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
 - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
 - .4 Summary of run time alarms: include point name, run time to date, alarm limit.
 - .5 Summary of start/stop schedules: include start/stop times and days, point name.
 - .6 Motor status summary.
 - .5 Report types:
 - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
 - .1 Points in accessible from this OWS (total connected for this location), multiple "areas".
 - .2 Area (points and systems in Area).
 - .3 Area, system (points in system).
 - .4 System (points by system type).
 - .5 System point (points by system and point object type).
 - .6 Area point (points by system and point object type).
 - .2 Area (points and systems in Area).
 - .6 Summary report: printout or display of point object data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
 - .7 Include preformatted reports as listed in Event/Alarm Module.
 - .13 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
-

- .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlayed with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
 - .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
 - .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.
 - .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
 - .1 Modify portion of graphic picture/schematic background.
 - .2 Delete graphic picture.
 - .3 Call up and cancel display of graphic picture.
 - .4 Define symbols.
 - .5 Position and size symbols.
 - .6 Define background screens.
 - .7 Define connecting lines, curves.
 - .8 Locate, orient, size descriptive text.
 - .9 Define, display colours of elements.
 - .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
 - .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
 - .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
 - .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress.
-

- .8 Contractor to utilize graphics package to generate system schematic diagrams as required in Section 25 90 01- EMCS: Site Requirements, Applications and Systems Sequences of Operation, and as directed by Engineer. Provide complete directory of system graphics, including other pertinent information. Utilize mouse or pointing device to "point and click" to activate selected graphic.
 - .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected function.
 - .14 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.
 - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
 - .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
 - .3 Alarm reports.
 - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
 - .2 Summary of points in maintenance alarm. Include at least point name, alarm type, current value.
 - .3 Analog alarm limit summary: include point name, alarm limits, deviation limits.
 - .4 Summary of alarm messages: include associated point name, alarm description.
 - .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
 - .5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
 - .1 Critical - 5 seconds.
 - .2 Cautionary - 10 seconds.
 - .3 Maintenance - 10 seconds.
 - .6 Display alarm messages in English and French.
 - .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
-

.8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgement of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgement of one alarm as acknowledgement of other alarms.

.9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:

- .1 Controller not responding - where possible delineate between controller and communication line failure.
- .2 Controller responding - return to normal.
- .3 Controller communications bad - high error rate or loss of communication.
- .4 Controller communications normal - return to normal.

.10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV).

Annunciate each non-expected status with alarm message.

.11 Implement software to provide remote alarm reporting via an e-mail system. This contractor to co-ordinate the EMCS with the e-mail system and to provide software and hardware as required to facilitate the e-mail reporting of EMCS alarm conditions using fully readable, individual, specific alarm messages. The alarm text and an optional supplementary instruction message shall be transmitted as a record to the e-mail address. A record that the e-mail occurred shall be sent to a text file on the Operator Workstation.

.12 It shall be possible to program e-mails according to a set schedule such that up to four enable/disable periods a day shall be allowed for each e-mail address to permit alarm transmission on a work shift basis.

.13 Provide programming and software as required to facilitate the transfer of the critical alarms annunciated on the EMCS to the e-mail system.

.15 Archiving and Restoration Module.

.1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.

- .2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
 - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .16 CDL Generator and Modifier Module.
- .1 CDL Generator module to permit generation and modification of CDLs.
 - .2 Graphical environment for creation of downloadable code controllers, the module will include a full library of symbols used by manufacturer for system product installed accessible to Owner's staff. Module to include graphic tools required to generate and create new object code for downloading to building controllers.
 - .3 Module to permit testing of code before downloading to building controllers.

2.7 ADDITIONAL SOFTWARE REQUIREMENTS

- .1 Enter soft copy submissions, including EMCS "Record" drawings specified in Section Section 25 05 02 - EMCS: Submittals and Review Process, in OWS. Enter as pdf file format.
- .2 Enter soft copy of Architectural, Electrical and Mechanical systems drawings in OWS. Electronic drawings to be provided by Engineer. Drawings to be in pdf format.
- .3 Enter soft copy of EMCS O. and M. manuals, specified in section 25 05 03 - EMCS: Project Record Documents, in OWS. Manuals to be in pdf file format.

2.8 TECHNICAL DATA

- .1 Network and connectivity: BACnet Ethernet, MS/TP, PTP, Annex J BACnet/IP, modem, serial cable.
 - .2 Integration and interoperability: BACnet compliant. Shall support Active X interface to other windows applications.
 - .3 Display capability: unlimited custom displays and resolution, dependent only on hard disk space and graphics hardware.
-

- .4 Security: 500 users maximum, each with unique access privileges. Adjustable auto logout shall protect unattended terminals.

2.9 ACCEPTABLE PRODUCT

- .1 Delta Orca View, Alerton, Automated Logic, Honeywell, Johnson Controls, Inversys, or approved substitute.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not used.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE, Applications Handbook, SI Edition.
 - .2 ASHRAE Standard 135 - BACnet - A Data Communications protocol for Building automation and Control Networks.
 - .3 ASHRAE Standard 135.1, Method of Test Conformance to BACnet.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205, Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 MAINTENANCE

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 General Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controllers quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units:
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication LANs to exchange information with other Controllers.
 - .3 Be capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

2.2 DESIGN REQUIREMENTS

- .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing the detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including the resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
 - .2 Total spare capacity for MCUs and LCUs: at least 25% of each point type distributed throughout the MCUs and LCUs.
 - .3 Field Termination and Interface Devices.
-

- .1 To conform to CSA C22.2 No. 205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logic devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring.
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input/output interface to accept as minimum AI, AO, DI, and DO functions as specified.
 - .7 Wiring terminations use conveniently located screw type or spade lug terminals.
 - .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 12 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0-10V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
 - .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 12 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0-10V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .6 DI interface equipment:
 - .1 Be able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 10 kHz.
 - .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
-

- .4 Controller's and associated hardware and software: operate in conditions of 0°C to 44°C and 20 % to .9 % non-condensing RH
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 provide surge and low voltage protection for interconnecting wiring connections.

2.3 MASTER CONTROL UNIT (MCU)

- .1 Primary function of MCU is to provide co-ordination and supervision of subordinate devices. Supervisory role shall include coordination of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
 - .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices. Include support for Open System protocols, BACnet.
 - .3 MCU local I/O capacity as follows:
 - .1 To have at least 16 I/O points of which minimum to be 2AO, 6AI, 4DI, 4DO.
 - .2 LCUs to be added to support system functions as indicated in I/O Summary List.
 - .4 Central Processing Unit (CPU).
 - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
 - .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
 - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include:
 - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
-

- .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS, CAB-Gateway, or locally installed floppy disk.
 - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
 - .5 Local Operator Terminal (OT):
 - .1 OT to:
 - .1 Have integral access/display panel where immediate access to OWS is not available.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs additions and modifications.
 - .3 Simultaneously display minimum of 16 points with full English identification to allow operator to view single screen dynamic displays depicting entire mechanical systems.
 - .2 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify setpoints.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify setpoint weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.
 - .13 Enter/modify analog differentials.
 - .3 OT to provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
 - .4 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
-

.5 OT to provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.6 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.4 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
 - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
 - .4 Include power supplies for operation of LCU and associated field equipment.
 - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.
 - .7 LCU to have 25% spare input and 25% output point capacity without addition of cards, terminals, etc.

2.5 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
-

- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
- .3 VAV Terminal Controller.
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
 - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
 - .3 Controller to operate independent of network in case of communication failure.
 - .4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.6 SOFTWARE

- .1 General.
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
 - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
 - .3 Include initial programming of Controllers, for entire system.
 - .2 Program and data storage.
 - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
 - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
 - .3 Programming languages.
 - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.
 - .4 Operator Terminal interface.
 - .1 Operating and control functions include:
-

- .1 Multi-level password access protection to allow user/manager to limit workstation control.
 - .2 Alarm management: processing and messages.
 - .3 Operator commands.
 - .4 Reports.
 - .5 Displays.
 - .6 Point identification.
 - .5 Pseudo or calculated points.
 - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
 - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
 - .6 Control Description Logic (CDL):
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
 - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
 - .3 Perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
 - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 Two position control.
 - .2 Proportional Integral and Derivative (PID) control.
 - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
 - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
-

- .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
- .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
- .1 Time of day scheduling.
 - .2 Calendar based scheduling.
 - .3 Holiday scheduling.
 - .4 Temporary schedule overrides.
 - .5 Optimal start stop.
 - .6 Night setback control.
 - .7 Enthalpy (economizer) switchover.
 - .8 Peak demand limiting.
 - .9 Temperature compensated load rolling.
 - .10 Fan speed/flow rate control.
 - .11 Cold deck reset.
 - .12 Hot deck reset.
 - .13 Hot water reset.
 - .14 Chilled water reset.
 - .15 Condenser water reset.
 - .16 Chiller sequencing.
 - .17 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
-

- .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
 - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
 - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
 - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
 - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
 - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999 events before reset.
 - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.7 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.8 POINT NAME SUPPORT

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

PART 3 - EXECUTION

3.1 LOCATION

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

3.2 INSTALLATION

- .1 Install Controllers in secure enclosures as indicated.
- .2 Provide necessary power from local 120V branch circuit panel

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
 - .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
 - .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.
-

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, heat resistant, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
-

- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150 mm as indicated.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature ed and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .6 Stability 0.02 degrees C drift per year.
 - .7 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.
 - .2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460mm or as indicated.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
-

- .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
- .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
- .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
- .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
- .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 PRESSURE TRANSDUCERS

- .1 Requirements:
 - .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
 - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
 - .6 Over-pressure input protection to at least twice rated input pressure.
 - .7 Output short circuit and open circuit protection.
 - .8 Accuracy: plus or minus 1% of Full Scale.

2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

- .1 Requirements:

- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.6 STATIC PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
 - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.7 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.5 % of output.
 - .5 Linearity: within 1.5 % of span.
 - .6 Deadband or hysteresis: 0.1% of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.8 VELOCITY PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
-

- .2 Maximum pressure loss: 37Pa at 1000 m/s.
- .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.9 VELOCITY PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.1 % of output.
 - .5 Linearity: within 0.5 % of span.
 - .6 Deadband or hysteresis: 0.1% of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.10 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.11 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
-

- .1 Room: for wall mounting on standard electrical box with without protective guard as indicated.
- .2 Duct, general purpose: insertion length = 460 mm.
- .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
- .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
- .5 Strap-on: with helical screw stainless steel clamp.

2.12 ELECTROMECHANICAL RELAYS

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 V AC.
 - .4 Relay to have visual status indication

2.13 SOLID STATE RELAYS

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator
 - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
 - .5 Relays to be CSA Certified.
 - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
 - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.14 CURRENT TRANSDUCERS

- .1 Requirements:
 - .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
-

- .1 4-20 mA DC.
- .2 0-1 volt DC.
- .3 0-10 volts DC.
- .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.15 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.16 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
 - .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
 - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
 - .3 Bearings: maintenance free, synthetic type of material.
 - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
 - .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
-

- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25 L/s/m² maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
 - .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.
 - .4 Use same manufacturer as damper sections.

2.17 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.18 PANELS

- .1 Free-standing wall mounted enamelled steel cabinets with hinged and key-locked front door.
 - .2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
 - .3 Panels to be lockable with same key.
-

2.19 WIRING

- .1 In accordance with Division 26 - Electrical.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
 - .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
 - .3 Temperature transmitters, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
 - .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
 - .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
 - .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
-

- .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 VAV Terminal Units: supply, install and adjust as required.
 - .1 Air probe, actuator and associated vav controls.
 - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
 - .3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
 - .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
 - .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
 - .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
-

- .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.
-

3.6 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.7 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 REFERENCE STANDARDS

.1 Public Works and Government Services Canada (PSPC) / Real Property Branch / Architectural and Engineering Services.

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:
<ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

1.3 SEQUENCING

.1 VAV Control:

.1 The setpoint on the thermostat is the heating setpoint. when the temperature drops to the set point the VAV box throttles to minimum position and turns on perimeter heat. When the temperature rises to the setpoint the perimeter heat is turned off. As the temperature rises the box throttles to allow more air to the space. At 1° above setpoint the box is at maximum air flow.

.2 Night setback is 18°C. This can be overridden by pushing the night setback override button.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Divisions 27, 28 and 33.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 7-15, Underground Systems.
 - .3 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .3 CAN/CSA Z462-18, workplace Electrical Safety as Applicable to Information Regarding Arc Flash Hazard and Definition of Arc Flash protection Boundary.
- .4 Install to be in accordance with National Building Code of Canada (NBCC) and Local Regulations.

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 ACTION AND INFORMATIONAL SUBMITTALS

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

- .1 Submit drawings signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .4 Quality Control: in accordance with Section 01 45 00 - Testing and 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 approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for new equipment for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

- .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 COORDINATION WITH UTILITY

- .1 Contract to engage and coordinate with utilities for work indicated on the drawings, and as required to provide installation of complete and fully functional systems.
- .2 Contractor to carry all associated costs.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Departmental Representative.
 - .1 Porcelain enamel decal signs, minimum size 175 x 250 mm.
-

- .2 Provide potential electric shock and arc flash hazard warning labels for equipment installed, in accordance with Section 26 05 01 - Arc Flash Hazard Protection.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: plastic laminate lamicaid 3 mm thick plastic engraving sheet, matt black finish face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. XX" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.

- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Panelboards: Indicate designated names of equipment, system and voltage characteristics.
- .11 Receptacles, Switches: indicate panel and circuit numbers.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

<u>Type</u>	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-2.
 - .2 Paint indoor distribution enclosures light gray to EEMAC 2Y-1.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do underground systems in accordance with CAN/CSA-C22.3 No.7 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
-

- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .3 Panelboards: as required by Code.
 - .4 Telephone outlets: 300 mm.
 - .5 Wall mounted telephone and interphone outlets: 1200 mm.
 - .6 Fire alarm horn-strobes: 2300 mm.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 ARC FLASH HAZARD PROTECTION

- .1 Provide arc flash hazard study and warning labels for equipment installed, in accordance with Section 26 05 01 - Arc Flash Hazard Protection.

3.9 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
 - .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm communications.
 - .6 The following systems/equipment shall be tested:
 - .1 Grounding system.
 - .7 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .3 Carry out tests in presence of Departmental Representative.
 - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .5 Manufacturer's Field Services:
-

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.6 Submit test results for Departmental Representative's review.

3.10 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

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

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

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Electrical equipment shall conform to Canadian Electrical Code requirements for electrical shock and arc flash hazard warning labels. Undertake electrical shock and arc flash study and analysis as per CSA Z462 Work Place Electrical Safety 2018 to define Arc Flash Incident Energy and Flash Protection Boundary information.
- .2 Labels shall be provided for equipment installed as indicted by CSA Z462.
- .3 Install Warning Labels. Warning labels to be self-adhesive type in highly visible locations. The labels shall be made of durable permanent adhesive and outdoor vinyl material with UV inhibited colours (UV resistant).
- .4 Scope:
 - .1 Accurate electrical system single-line diagram as required by CAN/CSA Z462. Include the following on the single line diagram:
 - .1 Nameplate data for electrical components (e.g. transformers, panelboards, switchboards, motor control centers, etc.).
 - .2 Cable sizes, types and lengths between electrical equipment components.
 - .3 Utility source data (to be provided by Departmental Representative).
 - .4 Verified overcurrent device settings.
 - .2 Short Circuit Study in accordance with ANSI standard C37 and IEEE standard 141-1993 (Red Book).
 - .3 Coordination Study in accordance with IEEE 242-2001 (Buff Book) to determine the proper overcurrent device settings that will balance system reliability through selective coordination while minimizing magnitude of an electrical arc flash hazard incident.
 - .4 Incident Energy Study in accordance with the IEEE 1584-2004a, "IEEE guide for Performing Arc Flash Hazard Calculations" in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.

- .5 Short circuit, protection coordination and arc flash hazard analyses shall be carried out utilizing SKM Power Tools 8. All electrical equipment shall be correctly identified and modelled within PTW program. The complete electronic project files shall be provided to Departmental Representative. The files shall include: project file symbol library (.prj), component library, any additions to the PTW library files (.lib), data block single lines (.drw), TCC curves, generated report files (.rpt) and any other related files.

1.2 SUBMITTALS

- .1 Comprehensive report that includes:
 - .1 Report summary with analysis methodology, findings and recommendations.
 - .2 Summary of input data for utility source, equipment and cables.
 - .3 Available fault current at each equipment location with comparison to equipment rating.
 - .4 Overcurrent device settings (e.g. pick-up, time delay, TCC curve).
 - .5 Incident energy level (calories/cm²) for each equipment location and recommended PPE.
 - .6 Overcurrent device coordination curve including related section of the single-line diagram.
 - .7 Report shall be stamped and signed by professional engineer registered and licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Labels:
 - .1 Installed warning labels (orange <40 cal/cm²) or danger label (red > 40 cal/cm²) in accordance with ANSI Z535.4-2011. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information as per Z462:
 - .1 Arc hazard boundary (centimeters).
 - .2 Arc flash incident energy (calories/cm²), and the corresponding working distance (centimeters).
 - .3 Voltage rating of the equipment.
 - .4 Limited approach distance (centimeters).
 - .5 Restricted approach distance (centimeters).
 - .6 Glove Class.
 - .7 Equipment/bus name.
 - .8 Date prepared.
 - .9 Arc flash hazard study preparer name and address.
 - .2 Labels to match those currently used on site. Departmental Representative to provide sample.
-

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Clean thoroughly enclosure surface prior to applying labels.
- .2 Install labels.

3.2 QUALITY ASSURANCE

- .1 Provide all necessary material, equipment, labour, and technical supervision to perform the arc flash hazard analysis.
- .2 Utilize engineers and technicians that are experienced and regularly perform electrical power system testing.
- .3 Personnel performing the arc flash analysis shall be trained and experienced in accordance with NETA Training Specification concerning the apparatus and systems being evaluated.

PART 1 - GENERAL

1.1 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of electrical, communications and safety and security components including removal of conduit, junction boxes, and devices and incidentals required to complete work described in this Section.

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 00.08 - Demolition For Minor Works.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .2 Workplace Health, Safety and Compensation Act: RSNL 1990 CHAPTER W-11.
- .3 Canada Occupational Health and Safety Regulations: SOR/86-304.

1.4 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 - .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes , cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 - .3 Remove and Salvage: Detach items from existing construction and deliver them to Representative Owner ready for reuse.
 - .4 Relocate: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
-

- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Departmental Representative's continued occupancy requirements during selective demolition and schedule staged occupancy and worksite activities as a defined Activity item in accordance with Section 01 32 16 - Construction Progress Schedule.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Workplace Health, Safety and Compensation Act: RSNL 1990 CHAPTER W-11.
 - .2 Canada Occupational Health and Safety Regulations: SOR/86-304.

1.8 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
 - .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform following activities:
 - .1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.
 - .2 Hazardous substances will be as defined in Hazardous Products Act.
 - .3 Stop work in area of suspected hazardous substances.
-

.4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.

.5 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to Work.

.6 Proceed only after written instructions have been received from Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED REPAIR MATERIALS

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.13 for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- .3 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 SALVAGE AND DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials will be removed from Project site; except for items indicated as being reused, salvaged, reinstalled, or otherwise indicated to remain Departmental Representative's property.
 - .2 Salvaged Materials: Carefully remove materials designated for salvage and store in a manner to prevent damage or devaluation of materials.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect work of this Section before tendering Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with use of the building by Departmental Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section with information contained in Section 02 41 00.08 and as follows:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
-

- .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
- .3 Disconnect and remove communication systems devices including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
- .4 Disconnect and remove telephone outlets, associated conduit, cabling and related accessories; maintain telephone service and main terminal backboard as is.
- .5 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
 - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- .6 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- .7 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .8 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .9 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .10 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with local requirements.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No. 18.4-04(R2013), Hardware For The Support Of Conduit, Tubing and Cable.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
 - .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
 - .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for copper bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
 - .5 Sized for conductors and bars as indicated.
 - .4 Clamps or connectors for armoured cable, TECK cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 20 - Wire and Box Connectors (0-1000 V).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No. 0.3-09(R2014), Test Methods For Electrical Wires and Cables.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE. Use RWU90 for outdoor installations.

2.2 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
-

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 PVC flame retardant jacket over armour for this project wet locations.
- .5 Connectors: anti short connectors.

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 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and In Ducts.
 - .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
 - .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
 - .4 Conductor length for parallel feeders to be identical.
 - .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
 - .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
-

- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In underground ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
 - .3 Provide dedicated neutral for each branch circuit.

3.4 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Install for short (less than 3 meters) length to lighting luminaries.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Waste Management and Disposal.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 65-13(R2018), Wiring Connectors.
 - .2 CSA C22.2 No. 41-13, Grounding and Bonding Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 CERTIFICATES

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority and include with maintenance manuals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
-

PART 2 - PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No. 65 as required, sized for conductors.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install stress cones, connectors and terminations in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".
- .2 Section 27 05 26 - Grounding and Bonding For Communications Systems.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International
 - .1 CSA 22.2 No.41-13, Grounding and Bonding Equipment.
 - .2 CSA Z462-18, Workplace Electrical Safety.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
 - .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, MHD, size as indicated.
 - .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
 - .4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
 - .5 Insulated grounding conductors: green, copper conductors, RW90, size as indicated. Minimum size #12 AWG.
 - .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
-

- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.
- .7 Compression connectors.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Run insulated ground wire in each conduit.
 - .2 Install connectors in accordance with manufacturer's instructions.
 - .3 Protect exposed grounding conductors from mechanical injury.
 - .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
 - .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
 - .6 Soldered joints not permitted.
 - .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
 - .8 Install flexible ground straps as required.
-

- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 ELECTRODES

- .1 Install rod, electrodes and make grounding connections as indicated.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 4/0 AWG copper conductors for connections to electrodes.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary 120/240 V and 347/600 V systems.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, fire pumps, distribution panels, outdoor lighting.

3.6 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone and sound systems, as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound systems: as per manufacturer's recommendations.
-

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduit, Conduit Fastenings and Conduit Fittings.
- .3 Section 27 05 28 - Pathways For Communications Systems.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended set in poured concrete walls and ceilings.
- .2 Hot dip galvanized (after fabrication) material for outdoor installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
 - .2 Secure equipment to poured concrete with expandable inserts.
 - .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
 - .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
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- .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 spacing in accordance with CSA C22.1.
 - .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.
 - .13 Support Channels are only to be installed above drop ceilings.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
-

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 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, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and Type 4X for outdoor.
 - .2 Covers Flush Mounted: 25 mm minimum extension all around.
 - .3 Covers Surface Mounted: screw-on turned edge covers.
-

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, latch lock 2 keys and catch. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and Type 4X for outdoor.
- .2 Type T Terminal: flush overlapping sides, mounting as indicated containing sheet steel backboard.

PART 3 - EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.
- .3 All junction boxes: indicate panel and circuit number.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Section 26 27 26 - Wiring Devices.
- .3 Section 27 05 28 - Pathways For Communications Systems.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
 - .2 102 mm square or larger outlet boxes as required.
 - .3 Gang boxes where wiring devices are grouped.
 - .4 Blank cover plates for boxes without wiring devices.
-

- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

- .1 Cast FS or FD copper-free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
 - .2 Knock-out fillers to prevent entry of debris.
 - .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
 - .4 Double locknuts and insulated bushings on sheet metal boxes.
-

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Use FS or FD boxes for outdoor and in wet areas installation.
- .8 Conduit fittings (condulets) shall be accessible (not concealed).
- .9 Each receptacle to have its panel and circuit number identified on lamicoid nameplate above device.
- .10 Receptacles to be installed with grounds down.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Section 27 05 28 - Pathways For Communications Systems.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18.2-06(R2016), Nonmetallic Outlets Boxes.
 - .2 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83 -M1985(R2003), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-M1984(R2016), Rigid PVC (Unplasticized) Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from the public.
-

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Rigid metal conduit: to CSA C22.2 No.45.1, hot dipped galvanized steel threaded.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 53 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .4 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 27 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT in wet locations.
 - .1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
-

- .2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .2 Conceal conduits except in unfinished areas.
 - .3 Use electrical metallic tubing (EMT) where not subject to mechanical injury.
 - .4 Use rigid pvc conduit underground.
 - .5 Use liquid-tight flexible metal conduit for connection to motors and vibrating equipment.
 - .6 Use rigid hot dipped galvanized steel threaded conduit where specified or subject to mechanical injury.
 - .7 Minimum conduit size for lighting and power circuits: 21 mm.
Minimum conduit size for communication systems: 27 mm.
 - .8 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .9 Mechanically bend steel conduit over 21 mm diameter.
 - .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
-

- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.
- .14 Do not secure conduits to mechanical systems piping or ducts, suspended ceiling, etc.

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 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Do not install conduits in slabs.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
 - .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.
-

3.7 CLEANING

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 33 65 76 - Direct Buried Underground Cable Ducts.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-Z809-08(R2013), Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2013, FSC Principle and Criteria for Forest Stewardship.
- .3 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 CABLE PROTECTION

- .1 38 x 50 mm planks pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: PRI Cable, SEC Cable, or TEL Cable impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
- .2 Polyethylene warning tape over full length of cable (raceway) route. Tape width of 75 mm with 4 mil tape thickness. Test on tape to read "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .2 Do not pull spliced cables inside ducts.
-

- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

- .1 Mark cable every 150 m along duct runs and changes in direction.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .3 Install warning tape over full length of ductbanks buried halfway between ductbank and grade level.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
 - .3 Check phase rotation and identify each phase conductor of each feeder.
 - .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
 - .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
-

- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for s specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 24 02 - Service Entrance Board.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI & C12.20-2010, Standard For Electricity Meters.
- .2 CSA International
 - .1 CAN3-C17-M84(R2015), Alternating - Current Electricity Metering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include meter and instruments wiring connections, accuracy, recording parameters, electrical characteristics, outline dimensions, panel drilling dimensions and installation cutout template.
 - .3 Provide electrical data for instrument current and potential transformers.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .2 Store and protect metering and switchboard instruments from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 METER

- .1 Three-phase owners digital meter for power energy and utilities metering complete with communications capability.
 - .2 Digital meter shall support the following applications:
 - .1 Power and Energy metering including: power, energy, demand and harmonics measurements. Suitable for revenue grade measurements to ANSI C12 for bill verification, and sub-metering applications.
 - .2 Power Quality Analysis.
 - .3 Cost allocation and billing.
 - .4 Demand and power factor control.
 - .5 Load studies and circuit optimization.
 - .6 Equipment Monitoring and Control including metering of utilities including high temperature hot water and domestic water supply.
 - .7 Preventative Maintenance alarms and event logging.
 - .3 Digital meter technical features shall include:
 - .1 Capability to measure:
 - .1 Tru RMS 3-phase voltage, current and power.
 - .2 Instantaneous 3-phase voltage current, frequency, and power factor.
 - .3 Energy: bi-directional, absolute and net.
 - .4 Demand: rolling block, preducted, and thermal.
 - .5 32 samples per cycle.
 - .6 Harmonics: individual and total harmonic distortion up to the 15th.
 - .7 Waveform recording.
 - .8 K-Factor.
 - .2 Communications requirements to include:
 - .1 Webmeter and MeterM@il allow distribution of metered data and alarms over the Internet. Provide server software and client software (3 single user licenses) if this is required.
-

- .2 Optional Ethernet port with EtherGate allows direct Ethernet-to-RS-485 data transfer.
- .3 Optional built-in modem with ModemGate.
- .4 Two RS-485 ports.
- .5 One front panel optical port standard.
- .6 Modbus RTU on serial, Ethernet, modem, and infrared ports.
- .7 DNP 3.0 on serial, modem, and infrared ports.
- .8 Modem call-back feature offers fast alarm response.
- .3 On-Board Data Logging on include:
 - .1 Scheduled or event-driven logging of up to 32 parameters.
 - .2 Sequence-of-events and min/max logging.
- .4 Setpoints for Control and Alarms to include:
 - .1 Setpoint on any parameter or condition.
 - .2 1 second operation.
- .5 Input and Outputs to include:
 - .1 4 digital inputs for status/counter functions.
 - .2 4 digital outputs for control/pulse functions.
 - .3 Optional analog inputs and outputs.
- .4 Digital meter to be programmable and settings to be adjustable by pushbutton panel integral to meter.
- .5 Indication of measurements, data logging, alarms and programming provided on digital readout panel integral to meter.

2.2 TEST TERMINAL BLOCKS

- .1 Test terminal blocks: as required.

2.3 INSTRUMENTS TRANSFORMERS

- .1 Provide Current Transformers and Potential Transformers as required and in accordance with Section 26 22 19 - Control and Signal Transformers.

2.4 SHOP INSTALLATION

- .1 Install meters and instrument transformers in separate compartment of switchboard.
 - .2 Ensure adequate spacing between current transformers installed on each phase.
-

- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

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 metering and switchboard instruments installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 METERING INSTALLATION

- .1 Install meters and instruments in location free from vibration and shock.
- .2 Make connections in accordance with diagrams.
- .3 Connect meter and instrument transformer cabinets to ground.

3.3 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.
 - .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
 - .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
 - .4 Perform tests to obtain correct calibration.
-

- .5 Do not dismantle meters and instruments.

3.4 TRAINING

- .1 Provide four (4) hours training on site by factory trained technician and demonstrate set-up and programming of the meter.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 27 26 - Wiring Devices.

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 lighting control devices. Include product characteristics, performance criteria and physical size.
- .3 Shop Drawings:
 - .1 Shop drawings to include electrical detail of devices, coverage range diagrams, schematic, wiring, and interconnection diagrams, and location of components.

1.3 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data of new lighting control devices and equipment for incorporation into manual.
- .2 Submitted data shall include indication of sensor devices' areas of coverage (coverage range).

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with the manufacturer's name and address.
 - .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area.
 - .2 Store and protect the devices from damage.
 - .3 Replace defective or damaged materials with new.
 - .3 Packaging Waste Management: remove and recycle packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
-

1.5 WARRANTY

- .1 The manufacturer to provide a 5 year warranty on all system components.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- .1 Intelligent lighting control devices shall consist of one or more basic lighting control components including room controller, occupancy sensors, vacancy sensors, relays, manual switch stations, and manual dimming stations.
- .2 Devices in this Section include low voltage and line voltage devices. Located as indicated on drawings.
- .3 Sensors and switches shall be white in colour.
- .4 Stand-alone room control.
- .5 Programmable on site.
- .6 Provide all required material such as conduit, boxes, wiring, connectors, hardware, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- .7 For low voltage control devices:
 - .1 Communication shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - .2 Shall be capable of being daisy-chain wired with CAT-5 low voltage cabling.
 - .3 Low voltage devices and associated room controllers to be compatible and from same manufacturer.

2.2 LOW VOLTAGE WIRED VACANCY SENSOR, CEILING MOUNT

- .1 Dual technology wired occupancy sensor: Manual-On/Auto-Off.
 - .2 Technology: dual technology, passive infrared (PIR) and ultrasonic, for both major and minor motion detection.
 - .3 Self-adaptive sensor automatically adjusting sensitivity and timing.
 - .4 Power: Class 2 low voltage wiring.
-

- .5 Field of View: 360°.
- .6 Coverage selected to suit specific areas and mounting height. Minimum Coverage: Major motion (ultrasonic) 19.5 x 9.8 m area, minor motion (ultrasonic) 13.7 x 7 m area, major motion (PIR) 6.7 m radius, minor motion (PIR) 3.7 m radius; with mounting heights of 2.4 m to 3.7 m.
- .7 Mounting: ceiling mount. Device to come complete with appropriate mounting bracket for ceiling type/material.
- .8 Adjustable Timeout Settings: 8 minute to 30 minutes.
- .9 Non-volatile memory to save settings during power loss.
- .10 Clearly visible indication of motion detection via LED.
- .11 All sensors shall have two RJ-45 ports or include RJ-45 input/output device (coupler/splitter) to allow for two connections.
- .12 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 low voltage cabling.

2.3 LOW VOLTAGE CONTROL SWITCHES AND DIMMABLE CONTROL SWITCHES

- .1 Low voltage button operated switches with the following features:
 - .1 Power: Class 2 low voltage wiring.
 - .2 One or two buttons as indicated.
 - .3 Switch shall come complete with 0-10 V dimming control as indicated.
 - .4 Devices shall recess into single-gang switch box and for a standard GFI opening.
 - .5 Communication shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - .6 Devices shall have at least two RJ-45 ports or include RJ-45 input/output device (coupler/splitter) to allow for two connections.
 - .7 All switches to come complete with cover plate.

2.4 LINE VOLTAGE WIRED OCCUPANCY SENSOR, CEILING MOUNT

- .1 Dual technology wired occupancy sensor: Auto-On/Auto-Off.
-

- .2 Technology: dual technology, passive infrared (PIR) and ultrasonic, for both major and minor motion detection.
- .3 Unit to include DIP switch for sensor adjustments.
- .4 Power: 120 VAC, 60 Hz.
- .5 Load Rating: minimum 800 W at 120 V.
- .6 Field of View: 360°.
- .7 Minimum Coverage: 10m x 10m area.
- .8 Mounting: ceiling mount. Device to come complete with appropriate mounting bracket for ceiling type/material.
- .9 Time delays: 5, 10, 15, 20, or 30 minutes, walk-through, test-mode.
- .10 Clearly visible indication of motion detection via LED.

2.5 RELAY/POWER PACK, 0-10V DIMMING

- .1 Relay/Power packs shall be plenum rated, and provide Class 2 low voltage power to devices.
- .2 Operating voltage: 120 VAC, 60 Hz.
- .3 Max switching load: 16A, via internal latching relay.
- .4 Load Dimming: 0-10 VDC dimmable ballast or LED drivers control.
- .5 Able support LED lighting loads.
- .6 All devices shall have two RJ-45 ports or two low voltage connectors.
- .7 Relay/Power pack parameters shall be available and configurable locally via device push-button.
- .8 CSA or cUL listed.

2.6 RELAY PACK, ELV DIMMING

- .1 Relay packs shall be plenum rated.
 - .2 For control of electronic low voltage lighting loads (dimmable LED track lighting).
-

- .3 Operating voltage: 120 VAC, 60 HZ.
- .4 Load Switching: via internal latching relay.
- .5 Load Dimming: 120 VAC electronic low voltage (ELV) control.
- .6 All devices shall have two RJ-45 ports or two low voltage connectors.
- .7 Relay pack parameters shall be available and configurable locally via device push-button.
- .8 CSA or cUL listed.

2.7 CATEGORY 5e CABLE

- .1 4 pair UTP - unshielded horizontal cable.
- .2 #24 AWG solid bare copper conductors.
- .3 Polyolefin insulation.
- .4 Ripcord.
- .5 PVC jacket.
- .6 Factory installed termination connectors.
- .7 Tested using a cable certification instrument that provides "Pass" or "Fail" information.
- .8 Cable to be installed in conduit with a maximum of 2-90° Bends or equivalent between pulling points.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed are acceptable for lighting controls installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
-

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTION

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

3.3 INSTALLATION

- .1 Locate and install devices and components in accordance with manufacturer's instructions.
- .2 Install all cables in conduit.

3.4 TESTING AND COMMISSIONING

- .1 Commissioning process shall include verification of all new lighting control devices and associated electrical components.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results For Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C9-02(R2016), Dry-Type Transformers.
 - .2 CAN/CSA-C802.2-12(R2017), Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 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.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .1 Store materials indoors in dry location 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.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN DESCRIPTION

- .1 Dry Type Transformer:
 - .1 Type: ANN.
 - .2 Single phase, 100 kVA, 600 V input, 240/120 V output, 60 Hz.
 - .3 Voltage taps: standard.
 - .4 Basic Impulse Level (BIL): standard.
 - .5 Hipot: standard.
 - .6 Average sound level: standard
 - .7 Impedance at 17 degrees C: standard
 - .8 Enclosure: CSA Type 2, removable metal front panel.
 - .9 Mounting: floor.
 - .10 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .11 Copper windings.
 - .12 Winding configuration to be as noted on drawings.
 - .13 Voltage Regulation to be 4% or better.
 - .14 Insulation: Class 220, 150 degrees C temperature rise.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Label size: 7.
 - .3 Nameplate wording: 'TX-1' - 100 kVA, 600-240/120 V, 1 Ph.
-

2.3 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results For Electrical.

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 of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Mount dry type 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 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
-

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 09 23.01 - Metering and Switchboard Instruments.
- .2 Section 26 24 02 - Service Entrance Board.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C61869-1:14, Instrument Transformers.
 - .2 CAN/CSA C60044-8-07(R2016), Instrument Transformers - Part 8: Electronic Current Transformers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control and signal transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 POTENTIAL TRANSFORMERS (PT's)

- .1 Primary voltage: 360V.
- .2 Secondary voltage: 120V.
- .3 Ratio: 3:1
- .4 Frequency: 60Hz.
- .5 Power factor: 0.7.
- .6 Continuous thermal rating: 200VA.
- .7 600V insulation level.
- .8 Primary and secondary terminals: compression type with slot screws accessible from the top of the the transformer.
- .9 Core: high-grade, grain-oriented steel, wound core.
- .10 Primary and secondary coils: wound from coated copper.
- .11 Housing: polyurethane.

2.2 CURRENT TRANSFORMERS (CT's)

- .1 Ratio: 400:5A.
 - .2 Frequency: 60Hz.
 - .3 VA rating: 15VA.
-

- .4 600V insulation level.
- .5 Terminals: brass studs with one flatwasher, lockwasher, and regular nut.
- .6 2 wire CT.
- .7 Metering accuracy: 0.3 B0.9.

2.3 MOUNTING BRACKETS

- .1 Potential transformers mounting brackets.
- .2 Fabricate brackets and channels from electrogalvanized code gauge painted steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control and signal transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install instrument transformers and ensure accessibility.

3.3 TESTING

- .1 Test to verify that all components of the system are installed as required.
 - .2 Test and commission all components.
-

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 09 23.01 - Metering and Switchboard Instruments.
- .2 Section 26 22 19 - Control and Signal Transformers.
- .3 Section 26 41 00.03 - Surge Protection Devices.
- .4 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 Service equipment to: CAN/CSA C22.2 No. 31-04.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for service entrance board and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
 - .2 Include time-current characteristic curves for circuit breakers and fuses.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide:
-

- .1 2 extra fuses for each type of instrument transformer.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect service entrance board from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE BOARD

- .1 Service Entrance Board: to CSA C22.2 No.31.
 - .2 Rating: 347/600V, 3 phase, 4 wire, amperage rating: as indicated, short circuit current (rms symmetrical) rating: as indicated.
 - .3 Equipment: free standing, dead front, size as indicated. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2.
 - .4 Owners meter: as indicated and in accordance with Section 26 09 23.01 - Metering and Switchboard Instruments.
-

- .5 Instrument transformers (CT's and PT's) for Utility Metering, in accordance with Section 26 22 19 - Control and Signal Transformers.
- .6 Distribution section.
- .7 Hinged access panels with captive knurled thumb screws.
- .8 Bus bars and main connections: 99.3% copper.
- .9 Identify phases with colour coding.
- .10 Integral surge protection device in accordance with Section 26 41 00.03 - Surge Protection Devices.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 Moulded case circuit breakers to Section 26 28 16.02 - Moulded Case Circuit Breakers.

2.3 GROUNDING

- .1 Copper ground bus extending full width of located at bottom.
- .2 Lugs at each end for size 2/0 grounding cable.

2.4 POWER SUPPLY AUTHORITY METERING

- .1 Mounting accessories and wiring for remote Utility Metering supplied by power supply authority:
 - .1 NL Power.

2.5 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .1 Service entrance board exterior: gray.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Nameplates:
 - .1 Black plate, white letters, size 7.
-

- .2 Complete board labelled: 600 V.
- .3 Main disconnect labelled: Main Breaker.
- .4 Branch disconnects labelled: as indicated.

2.7 WARNING SIGNS

- .1 Provide warning sign in accordance with Section 26 05 00 - Common Work Results For Electrical.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for service entrance board installation with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Locate service entrance board in electrical room as indicated on drawings.
 - .2 Connect main secondary service to line terminals of main breaker.
 - .3 Connect load terminals of distribution breaker's to feeders.
 - .4 Check factory made connections for mechanical security and electrical continuity.
 - .5 Run one grounding conductor bare copper from ground bus to building ground.
 - .6 Check trip unit settings against co-ordination study to ensure proper working and protection of components.
-

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 09 25 - Lighting Control Devices.
- .2 Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".
- .3 Section 26 41 00.03 - Surge Protection Devices.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.178.1-14, Transfer Switch Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 LINE VOLTAGE SWITCHES

- .1 15 A, 120 V, single pole switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
 - .6 3-Way or 4-way switch where indicated.
 - .7 Complete with red pilot light where indicated.
 - .8 Complete with 0-10V dimming slider where indicated.
- .3 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.

- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

2.3 GENERATOR PLUG INLET

- .1 Male inlet for accepting recaptable plug from generator.
- .2 Mechanical interlock for connection/disconnection in the "off" position only.
- .3 Mechanical disconnect handle.
- .4 Short circuit ratings: 10 kAIC.
- .5 Nominal voltage: 240/120V, 1 Ph.
- .6 Current rating: as indicated.
- .7 CSA Type 4X Enclosure.
- .8 CSA 22.2 No. 14 certification.
- .9 Generator plug inlets from one manufacturer throughout project.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Plastic white cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated. Cover plates exposed to the weather to be marked "Extra Duty".

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical, unless indicated otherwise.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical, unless indicated otherwise.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFCI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
-

-
- .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section Section 26 24 02 - Service Entrance Board.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Include time-current characteristic curves for provided breakers.
 - .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
-

- .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title:
 - .2 End user's reference number:
 - .3 List of circuit breakers:

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and ground-fault circuit-interrupters, to CSA C22.2 No. 5
-

- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating same as associated board. Series rating for breakers is not acceptable.
- .7 Service entrance rated for main circuit breaker in service entrance board.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP MAIN BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, long time, short time instantaneous tripping for phase and ground fault short circuit protection. Breaker with adjustable pickup and the delay values.
- .2 Circuit breaker equipped with two sets of auxiliary contacts. One set of contacts shall close on trip to provide trip status. The second set of contacts shall close when the breaker is in the OFF position to provide OFF status.

2.4 OPTIONAL FEATURES

- .1 Include:
 - .1 On-off locking device as indicated.
 - .2 Handle mechanism.
-

2.5 ENCLOSURE

- .1 Locate and mount in enclosure as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 27 26 - Wiring Devices.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144-M91(R2015), Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PB 2.2-14, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to Departmental Representative and certificate that system as installed meets criteria specified.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single pole ground fault circuit interrupter for 15 A, 125 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A, 120 V circuit interrupter and duplex U-ground receptacle, CSA Type 5-15R, colour white, complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 Matching cover plate.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and co-ordinate with Section 01 45 00 - Testing and Quality Control if required.
- .2 Arrange for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.
- .3 Demonstrate simulated ground fault tests.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
-

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

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA-C22.2 No.4-16, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMJ-J-162-2016 and UL 98).

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 disconnect switches and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Non-fusible, Horsepower rated disconnect switch in CSA enclosure minimum Type 2 for indoor application and Type 4X for outdoor application, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

2.3 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results For Electrical.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
-

3.2 INSTALLATION

- .1 Install disconnect switches as per manufacturers instructions.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14-13, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2015), Industrial Control and Systems: General Requirements.

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 control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.3 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 OPERATOR CONTROL STATIONS

- .1 Enclosure: to provide a degree of environmental protection equal to or higher than CSA Type 2, surface mounting unless otherwise noted.

2.4 SELECTOR SWITCHES

- .1 Maintained 2 and 3 position labelled as indicated, contact arrangement as indicated, rated 120 V, 20 A, AC.
-

2.5 CONTROL AND RELAY PANELS

- .1 Panel enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2. Steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.6 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 120 or 240 V as indicated, 60 Hz, AC.
- .3 Secondary: 120 V, AC.
- .4 Rating: 150 VA.
- .5 Secondary fuse: 3 A unless otherwise indicated.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.7 INDICATING LIGHTS

- .1 Heavy duty oil tight, full voltage, LED type, push-to-test, lens colour: as indicated, supply voltage: 120 VAC, lamp voltage: 120 VAC, labels as indicated.

2.8 WARNING SIGNS

- .1 Provide warning signs (where applicable) in accordance with Section 26 05 00 - Common Work Results For Electrical.

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 control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
-

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install control and relay panels, and control devices and interconnect as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 NEMA ICS 2, Industrial Control and Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 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.
 - .7 Certifications and approvals.

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

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2. Full size starters (half size are not acceptable).

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One overload heater, manual reset, trip indicating handle.
 - .3 Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2.
- .2 Accessories:
 - .1 Toggle switch: heavy duty oil tight type, labelled as indicated.
 - .2 Indicating light: heavy duty oil tight type, and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

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 Starter designation label, black plate, white letters, size 1, engraved as indicated.

2.5 WARNING SIGNS

- .1 Provide warning signs (where applicable) in accordance with Section 26 05 00 - Common Work Results For Electrical.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire, starters and controls as indicated.
- .3 Ensure correct fuses and overload device elements installed.
- .4 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 for 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 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results For Electrical.
- .2 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.178-1-14, Transfer Switch Equipment.
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA ICS 2-200(R2005), Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Make, model and type.
 - .2 Load classification:
 - .1 Motor load: kW.
 - .2 Restricted use: resistance and general loads, 0.8 pf or higher kW.
 - .3 Single line diagram showing controls and relays.
 - .4 Description of equipment operation.
 - .5 Dimensioned enclosure and interior layouts drawings.
 - .6 Wiring diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Detailed instructions to permit effective operation, maintenance and repair.
 - .3 Technical data:
 - .1 Schematic diagram of components.
-

- .2 Illustrated parts listed with parts catalogue numbers.
- .3 Certified copy of factory test results.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CAN/CSA-C60044.
- .2 Contactors: to ANSI/NEMA ICS2.

2.2 MANUAL TRANSFER SWITCH

- .1 Heavy duty, unfused, double-throw switch, with vertical oriented switches operated by a single handle, manually operated, mechanically held and interlocked. Ratings as indicated on Single Line Diagram. Short circuit rating of 10 kAIC, unless indicated otherwise.
 - .2 Three pole switch with solid neutral.
 - .3 Three switch positions for normal power, emergency power, and power off. Switch to be padlockable in OFF position.
 - .4 Switch approved for manually on-load transfer power source between normal power and emergency power supplied by portable generator.
 - .5 Copper bus and lugs.
-

- .6 Refer to Section 26 27 26 - Wiring Devices Clause 2.4 for portable generator set outlet requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect transfer equipment as per manufacturers recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results For Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in emergency power position to ensure proper emergency unit operation.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 28 - Grounding - Secondary.
- .2 Section 26 24 02 - Service Entrance Board.
- .3 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 SPD units and components shall be designed, manufactured and tested in accordance with the latest applicable standards.
- .2 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - .2 IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - .3 IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 UL 1283 - Electromagnetic Interference Filters.
 - .2 UL 1449 3rd Edition - Standard for Safety for Surge Protective Devices.
 - .3 UL 96A - Installation Requirements for Lightning Protection Systems.
- .4 NEMA LS-1-1992, Low Voltage Surge Protection Devices.
- .5 NFPA 780, Standard for the Installation of Lightning Protection Systems.
- .6 International Standards organization
 - .1 ISO 9001, Quality management Systems - Requirements.
 - .2 ISO 14001, Environmental Management Systems - Requirements with Guidance for Use.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for surge protective devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Unit Performance Characteristics.
 - .2 Unit Features.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect surge protection devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICE (SPD)

- .1 Location category: B - indoor service entrance.
 - .2 Exposure level: 2 - medium.
 - .3 Operational condition:
 - .1 Temperature: -40°C to +50°C.
 - .2 Humidity: 95% RH, non-condensing atmosphere.
 - .3 Altitude: 0 - 3600 m.
 - .4 Frequency: 60 Hz.
 - .5 Nominal Voltage: 347/600 Volts.
 - .4 SPD shall be MOV based, tested per IEEE C62.41.1.
 - .5 SPD component parts: to UL 1449 3rd Edition, NEMA LS 1, UL 1283 and cUL.
 - .6 SPDS characteristics:
 - .1 Protective Mode: All modes (L-N, L-G, L-L and N-G).
 - .2 The maximum UL-1449, 4th Edition, Voltage protection Rating (VPR) for the device shall not exceed:

Mode	L-N	N-G	L-G	L-L
Volts	1500	1500	1500	3000
 - .3 Nominal Discharge Current (In)): not less than 20kA.
 - .4 Short Circuit Current Rating (SCCR): 200kA.
 - .5 Maximum Surge Current: 125kA per mode 9250kA per phase).
 - .6 MCOV (maximum continuous operating voltage): greater than 115% of nominal system operating voltage.
 - .7 Unit shall include high-performance EMI/RFI noise rejection filter.
 - .1 Noise alteration: less than or equal to 50 dB, from 10 kHz to 100 MHz.
 - .2 Filter bandwidth: 10 kHz to 100 MHz.
 - .8 Response time: less than or equal to 1 ns.
 - .9 Integral fusing.
 - .10 Approved disconnect means.
 - .7 Features:
 - .1 Monitoring of internal fuses and MOV's.
 - .2 Status indicator lights on each phase.
 - .3 Trouble light.
 - .4 SPDT (form C) auxiliary contact.
-

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 secondary lightning arresters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 SPD device shall be integral to the switchboard. Lead length shall not exceed 600 mm.
- .2 Connect SPD as per manufacturer recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENT

- .1 Section 26 09 25 - Lighting Control Devices.
- .2 Section 26 52 00 - Emergency Lighting.

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.
 - .1 ASTM F1137-11E1, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International).
- .4 ICES-005-07, Radio Frequency Lighting Devices.
- .5 Underwriters' Laboratories of Canada (ULC).
- .6 Parks Canada
 - .1 Guidelines and Specifications for Outdoor Lighting at Parks Canada.

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.
 - .2 Provide complete photometric data prepared by independent testing laboratory for all luminaires for review by Departmental Representative.
-

.3 Photometric data to be IESNA LM79 compliant and shall include as a minimum the following information: Test Lab, Catalog Number, Description LED Manufacturer, Luminaire Output in Absolute Photometry, Driver Manufacturer and Model Number, Input Wattage, Space Criterion.

- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Testing and Quality Control.

.1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and warranty information.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of damaged or faulty LED drivers and or luminaires.
- .6 Disposal of old PCB filled ballasts.
- .7 Disposal of fluorescent lamps as per local regulations.

PART 2 - PRODUCTS

2.1 LAMPS

- .1 Refer to Luminaire Schedules on Drawings.

2.2 LED DRIVERS

- .1 LED Driver.
- .1 Rating: 120 V, 60 Hz.
- .2 Mounting: integral to luminaire.

.3 Colour temperature and colour rendering index (CRI): refer to Luminaire Schedule.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

- .1 As indicated in luminaire schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.
 - .1 See luminaire schedule on drawings for additional mounting information and requirements.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .3 Direct heads of track lighting.
 - .1 Adjust angle of track heads intended for general lighting to attain even lighting distribution.

3.4 CLEANING

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

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 26 50 00 - Lighting.
- .4 Section 26 52 13.16 - Exits Lights.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.141-15, Emergency Lighting Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months. Battery shall be pro-rated after five (5) years.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
 - .2 Supply voltage: 120 VAC.
 - .3 Output voltage: 12 VDC.
 - .4 Operating time: 30 minutes; 120 minutes in electrical room only.
 - .5 Battery: sealed, maintenance free.
 - .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
 - .7 Solid state transfer circuit.
 - .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
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- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED. Rating as indicated on drawings.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: White.
- .13 Emergency Lighting Battery Unit in Electrical Room to include: Auto test and self diagnostic features.
- .14 Auxiliary equipment:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 Battery disconnect device.
 - .4 AC input and DC output terminal blocks inside cabinet.
 - .5 Bracket.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Connect emergency battery units to lighting circuits.
- .3 Direct heads.
- .4 Test and demonstrate successfully the operation of all emergency lighting. Test each unit for 30 minutes on emergency.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 52 00 - Emergency Lighting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting.
 - .2 CSA C860-11(R2016), Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101-2018, Life Safety Code.
- .3 International Organization for Standardization (ISO)
 - .1 ISO 3864-1 2011, Graphical Symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings.
 - .2 ISO 7010 2011, Safety colours and safety signs - Registered safety signs.
- .4 National Building Code of Canada (NBCC), 2015.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
-

1.5 WARRANTY

- .1 For batteries in this section: 12 months warranty period is extended to 120 months. Battery shall be pro-rated after five (5) years.

PART 2 - PRODUCTS

2.1 SELF-POWERED UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: Extruded aluminum housing, brush aluminum finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: Low power LEDs.
- .5 Operation: designed for over 100,000 hours of continuous operation without relamping.
- .6 Face plate to remain captive for relamping.
- .7 Wall or ceiling mounted as indicated.
- .8 Single face as indicated.
- .9 Supply voltage: 120 V.
- .10 Battery back-up as indicated.
- .11 Battery: seal, maintenance free.
- .12 Operating time: 30 minutes minimum.
- .13 Graphics: Green pictogram and white graphical symbol to ISO 3864-1. Dimensions to ISO 7010.

2.2 COMBINATION EXIT AND DUAL-HEAD EMERGENCY LIGHT UNITS

- .1 Exit lights: to CSA C22.2 No. 141 and CSA C860.
 - .2 Housing: Extruded aluminum housing, brush aluminum finish.
 - .3 Face and back plates: extruded aluminum.
 - .4 Input voltage: 120 VAC.
-

-
- .5 Lamps: long-life white LEDS for face plate. Two 4-Watt LED emergency heads for egress illumination. Emergency Heads shall require no tool to adjust or aim.
 - .6 Output voltage: 12 VDC.
 - .7 Unit shall provide a minimum of 30 minutes of emergency operation upon AC power failure.
 - .8 Sealed, maintenance free, Lead-Calcium battery.
 - .9 Wall or ceiling mounted as indicated.
 - .10 Graphics: Green pictogram and white graphical symbol and directional arrows to ISO 3864-1. Dimensions to ISO 7010.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in on position.
- .4 Direct emergency-lighting heads on combination units.

3.3 CLEANING

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 28 - Grounding - Secondary.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute
 - .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-606-2012, Administration Standard for the Commercial Telecommunications Infrastructure.
- .3 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
 - .1 Nationally Recognized Testing Laboratory (NRTL).

1.3 SYSTEM DESCRIPTION

- .1 Existing telecommunications grounding and bonding system consist of grounding busbars and other bonding conductors.
- .2 Existing system provides ground reference for telecommunications systems within building.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
-

- .2 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 6 AWG copper conductor, green insulated marked to: ANSI J-STD-607-A.

2.2 WARNING LABELS

- .1 Non-metallic warning labels in English to: ANSI J-STD-607-A.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

PART 3 - EXECUTION

3.1 BONDING CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6 AWG copper conductor.

3.2 BONDING TO TMGB

- .1 Bond metallic raceways in electrical room to TMGB using 6 AWG green insulated copper conductor.
- .2 For cables within electrical room having shield or metallic member, bond shield or metallic member to TMGB using 6 AWG green insulated copper conductor.

3.3 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 28 - Grounding - Secondary.
- .2 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 27 10 05 - Structured Cabling For Communications Systems.

1.2 REFERENCE STANDARDS

- .1 Telecommunications Industry Association (TIA/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces.
- .2 ANSI-J-STD-607-A-(2002), Joint Standard - Commercial Building Grounding (earthing) and Bond Requirements for Telecommunications.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2018, Canadian Electrical Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
-

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communication raceway systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Additions/renovations to existing communications raceways system consist of outlet boxes, cover plates, conduits, junction and pull boxes, sleeves and caps, fish wires and service fittings. System to support CAT 3 and CAT 6 rated communications cabling installation and operations.
- .2 Grounding and bonding conductors and accessories.

2.2 MATERIAL

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. Conduit minimum size 27 mm.
 - .2 Junction and pull boxes: in accordance with Section 26 05 31 - Junction and Pull Boxes.
 - .3 Outlet boxes EMT type and fittings: in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and fittings. Double gang boxes, minimum 100 mm by 100 mm by 54 mm deep equipped with 12.5 mm single gang plaster ring or raised adapter plate for communications outlet boxes.
 - .4 Fish wire: polypropylene type.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install conduit system, including fish wire, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, service poles, miscellaneous and positioning material to constitute complete system.
 - .2 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box.
 - .3 Firestop material, system and methods shall conform to applicable codes.
 - .4 All conduit runs shall be a maximum of 30m in length with a maximum of two 90-degree bends between pull points.
 - .5 Pull boxes are not to be used for changes in direction; all wiring is to be pulled straight through and direction changes shall be via conduit elbows past the pull box.
 - .6 Install outlet boxes in locations identified and within 300 mm of adjacent electrical duplex receptacles, unless otherwise indicated on the drawings. Wherever possible, the face of the plastic, ring should be installed flush with the finish wall.
-

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common work Results For Electrical.
- .2 Section 26 05 29 - Hangers and Supports For Electrical Systems.
- .3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214-17, Communications Cables (Bi-National standard with UL 444).
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
 - .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
 - .3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 SYSTEM DESCRIPTION

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair terminations, connectors, and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.
- .2 Installed in physical star configuration with separate horizontal sub-systems.
 - .1 Horizontal cables link work areas to telecommunications.

1.4 CLOSEOUT SUBMITTALS

- .1 Operations and Maintenance Manuals:
 - .1 Provide maintenance details including:
 - .1 List of cables, hardware and components.
 - .2 Copies of approved shop drawings.
 - .3 List of spare parts and supplies.
-

.4 Test and verification reports.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .2 The cable installer shall have full working knowledge of cabling low voltage applications such as, but not limited to, Non-Secure Data/Voice communications cabling systems and:
 - .1 Have knowledge of all applicable Telecommunication standards such as but not limited to: CSA, TIA/EIA, IEEE and ANSI.
 - .2 Have experience in the installation of pathways and support for horizontal cabling.
 - .3 Be experienced in the installation and testing of telecommunication network cabling system.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with the manufacturer's name and address.
- .2 Waste Management and Disposal: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FOUR-PAIR 100 W BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm, 24 AWG, balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-B.2. Cable category identified on sheath.
-

2.2 WORK AREA UTP 4-PAIR MODULAR JACK

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568- B.2:
 - .1 In self-contained surface-mount box, 1 jack per box, white in colour.
 - .2 Mounted in compatible single gang faceplate, flush angle entry, white in colour.
 - .3 Insert modules shall meet or exceed the EIA/TIA Category 6 standard. The inserts shall be eight pin RJ45 IDC type connectors. Modules shall be compatible with outlet faceplates and shall be white in colour, matching faceplate colour. Shall accept four- or six-position modular plugs while providing proper electrical connection and not damaging telecommunication out/connector (jack).

2.3 TWO-PAIR CATEGORY 3 TWISTED PAIR CABLE

- .1 Two-pair, 24 AWG, unshielded-twisted-pair (UTP) cable, flame tested classification FT6 to: CSA-C22.2 No. 214, Category 3 (Cat 3) to: TIA/EIA-568-B.2. Cable category identified on sheath.

2.4 WORK AREA UTP 2-PAIR MODULAR JACK

- .1 Six-position, four-conductor modular jack ("RJ-11"), Category 3 to TIA/EIA-568-B.2:
 - .1 In self-contained surface-mount box, 1 jack per box, white in colour.
 - .2 Mounted in compatible single gang faceplate, flush angle entry, white in colour.
 - .3 Insert modules shall meet or exceed the EIA/TIA Category 3 standard. The inserts shall be four pin RJ11 IDC type connectors. Modules shall be compatible with outlet faceplates and shall be white in colour, matching faceplate colour. Shall accept four- or six-position modular plugs while providing proper electrical connection and not damaging telecommunication out/connector (jack).

2.5 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 IDC Terminal strips, 25 pair, for terminating multi 4 pair 100 W balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6 to: TIA/EIA-568-B.2.
-

- .2 Consolidation point, terminates UTP horizontal cables from telecommunications room on IDC terminations. Cables extending to work areas terminate on IDC terminal strips type T568A. Category 6 to: TIA/EIA-568-B.2.

2.6 UTP CROSS-CONNECT WIRE

- .1 Category 6, 4 pairs to: TIA/EIA-568-B.2.
- .2 Category 3, 2 pairs to TIA/EIA-568-B.2.

2.7 UTP PATCH CORDS

- .1 Factory-installed male plug at one end to mate with "RJ-45" jack and other end to mate with terminal strip Category 6, 4 pairs to: TIA/EIA-568-B.2.
- .2 Factory-installed male plug at one end to mate with "RJ-11" jack and other end to mate with terminal strip Category 3, 1 pairs to: TIA/EIA-568-B.2.

2.8 UTP WORK AREA CORDS

- .1 Provide Cat 6 patch cords, 3 metres long, each end equipped with "RJ-45" plug to: TIA/EIA-568-B.2.
- .2 Provide Cat 3 patch cords, 3 metres long, each end equipped with "RJ-11" plug to: TIA/EIA-568-B.2.
- .3 The quantity shall be one per new or relocated outlet. Exact length to be coordinated on site with Departmental Representative.

PART 3 - EXECUTION

3.1 INSTALLATION OF CROSS-CONNECT HARDWARE

- .1 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.
-

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits from telecommunication head-end equipment to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.
- .2 Terminate horizontal cables at telecommunications head-end equipment and at consolidation point.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .3 Coil spare cables and store in ceiling space in zone.
- .4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results .
 - .1 Perform tests for Permanent Link on installed cables, including spares:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
 - .2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from telecommunications head-end equipment, including shortest and longest drops should more than 5% of tested cables fail, test remaining cross-connected data cables.
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
- .2 Provide record of results to: TIA/TSB-140.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fire devices.
- .2 Related Requirements:
 - .1 Section 26 05 00 - Common Work Results For Electrical.

1.2 REFERENCE STANDARDS

- .1 Government of Canada
 - .1 NBCC-2015, National Building Code of Canada.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Installation of Fire Alarm Systems.
 - .2 ULC-S525, Audible Signal appliances for Fire Alarm.
 - .3 CAN/ULC-S526, Visual signal Devices for Fire Alarm Systems, Including Accessories.
 - .4 CAN/ULC-S530, Heat Actuated Fire Detectors.
 - .5 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
 - .6 CAN/ULC-S537, Verification of Fire Alarm Systems.
- .3 The latest edition of the above standards shall apply.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data and shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit manufacturer's instructions, printed product literature and data sheets for fire alarm equipment/devices and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
-

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data: submit operations and maintenance data for fire alarm devices for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .3 Include:
 - .1 Instructions to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.

1.5 QUALITY ASSURANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Service:
 - .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Departmental Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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.
 - .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Storage and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .3 Waste Management and Disposal:
-

.1 Construction/Demolition Waste Management and Disposal:
separate waste materials for reuse and recycling in accordance
with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- .1 The building fire alarm system is existing. The scope of work consists of minor modifications.
- .2 New signaling and initiating devices to be compatible with existing system. Existing building fire alarm panel is Simplex 4100.
- .3 New signaling and initiating devices to be connected to existing system using existing wiring configuration. All wiring in conduit.
- .4 Equipment and devices: ULC listed and labeled and supplied by single manufacturer.
- .5 Audible signal devices: to CAN/ULC-S525.
- .6 Visual signal devices: to CAN/ULC-S526.
- .7 Heat Detectors: to CAN/ULC-S530.
- .8 Regulatory Requirements:
 - .1 System components: listed by ULC and comply with applicable provisions for National Building Code, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE

- .1 The sequence shall remain as is.

2.3 AUDIBLE AND VISUAL SIGNAL DEVICES

- .1 Combination Horn/Strobe:
 - .1 Operating voltage: 24 VDC nominal.
 - .2 Semi-flush on surface, wall mounted type as indicated.
 - .3 Red polycarbonate housing with bilingual FIRE markings.
 - .4 flashing strobe, semi-flush on clear polycarbonate strobe lens.
-

- .5 Field selectable candela output: 75 cd and 110 cd, 1 flash per second rate.
- .6 Field selectable high and low sound output.
- .7 synchronized operation.

2.4 AUTOMATIC ALARM INITIATING DEVICES

- .1 Combination Heat Detector:
 - .1 Combined fixed temperature (57°C) and rate-of-rise (9°C) type, self restoring.
 - .2 Conventional type initiating device.
 - .3 Positive operating indication for fixed temperature element.
 - .4 Heat detector to be surface mounted to ceiling.

2.5 WIRING

- .1 Solid copper, twisted pair CSA FAS 105, FT-4 cables: rated 300V.
- .2 Each conductor shall be permanently labeled at both ends.
- .3 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To signal circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .6 Colour code wiring.
- .7 All fire alarm wiring shall be installed in conduit.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm equipment/devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
-

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524
- .2 Locate and install the detectors as indicated and connect to alarm circuits.
- .3 Install all audible/visual devices and connect to signalling circuits.
- .4 Provide wiring in conduit as required to ensure system continuity between new and existing fire alarm devices.
- .5 Ensure that wiring is free of opens, shorts and grounds, before system testing and handing over.
- .6 Identify circuits and other related wiring at terminal boxes.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
 - .2 Notify Departmental Representative 5 working days in advance of tests so that Departmental Representative can witness tests. Also provide written Certification of Verification.
 - .3 Fire alarm system verification shall be carried out by registered fire alarm technicians.

3.5 CLEANING

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

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

PART 1 - GENERAL

1.1 RELATED REFERENCES

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A82/A 82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM C478/C478M-18, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .3 ASTM D1056-14, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A3000-13, Cementitious Materials Compendium (consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .3 CSA G30.3-M1983(R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
 - .4 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
 - .5 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
-

- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Divert unused and broken concrete materials from landfill to local facility as approved by Departmental Representative.
- .6 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 PVC DUCTS

- .1 Rigid PVC ducts, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 CABLE PULLING EQUIPMENT

- .1 Pulling iron: galvanized steel rods, size and shape as indicated.
- .2 Pull rope: 6 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.4 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "PRI", "SEC" or "TEL" impressed in top surface, with arrows to indicate change in direction of duct runs.
-

2.5 WARNING TAPE

- .1 4 mil Polyethylene warning tape, 75 mm in width. Text on tape to read "CAUTION BURIED ELECTRICAL LINE BELOW".

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install underground duct banks including formwork.
 - .2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 100% of maximum proctor dry density.
 - .3 Open trench completely between manholes to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
 - .4 Prior to laying ducts, construct "mud slab" not less than 75 mm thick.
 - .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
 - .6 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
 - .7 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .8 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
 - .9 Use bell ends at duct terminations in manholes or buildings.
 - .10 Use conduit to duct adapters when connecting to conduits.
 - .11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
-

- .12 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .13 Allow concrete to attain 50% of its specified strength before backfilling.
- .14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .15 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .16 Immediately after placing of concrete, pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .17 Install four 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 15M dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.
- .18 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run. Place concrete duct marker at ends of such duct runs. Construct markers and install flush with grade.
 - .2 Mark ducts every 150 m along straight runs and changes in direction.
 - .3 Where markers are removed to permit installation of an additional duct, reinstall existing markers.
-

- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Provide drawings showing locations of markers.
- .6 Lay warning tape throughout ductbank length, at half-way distance between finished grade level and top of ductbank.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by Departmental Representative prior to placing.
 - .2 Placement of concrete and duct cleanout to be done when Departmental Representative is present.

3.4 CLEANING

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

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 211.2-06(2016), Rigid PVC (unplasticized) Conduit.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for solvent cement. Indicate VOC content.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Place materials defined as hazardous or toxic in designated containers.
 - .5 Fold up metal banding, flatten and place in designated area for recycling.
-

- .6 Do not dispose of preservative treated wood through incineration.
- .7 Do not dispose of preservative treated wood with other materials destined for recycling or reuse. Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill as approved by Departmental Representative.
- .8 Dispose of unused wood preservative material at official hazardous material collections site. Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .9 Dispose of unused solvent cement at an official hazardous material collections sites as approved by Departmental Representative. Do not dispose of unused solvent cement into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: to CSA C22.2 No. 211.1, with moulded fittings, for direct burial expanded flange ends. Trade size as indicated. Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, and adaptors same product material as duct, to make complete installation.
- .3 Rigid PVC 90° and 45° bends.
- .4 Rigid PVC 5° angle couplings.
- .5 Expansion joints every 50 m and as required.
- .6 Utilization of PVC split ducts is not permitted.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.
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2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded polypropylene pull rope tensile strength 5 kN.

2.4 WOOD PLANKS

- .1 38 mm thick (min.) chemically pressure treated (copper chromium arsenate) wood planks, extend 50 mm beyond conduit on each side.

2.5 WARNING TAPE

- .1 4 mil polyethylene warning tape 75 mm in width. Text on tape to read "CAUTION BURIED ELECTRIC LINE BELOW".

2.6 MARKERS

- .1 Concrete type cable markers: as indicated, with words: "PRI", "SEC" or "TEL" impressed in top surface, with arrows to indicate change in direction of duct runs.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install duct in accordance with manufacturer's instructions.
 - .2 Clean inside of ducts before laying.
 - .3 Ensure full, even support every 1.5 m throughout duct length.
 - .4 Slope ducts with 1 to 400 minimum slope.
 - .5 During construction, cap ends of ducts to prevent entrance of foreign materials.
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- .6 Pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Install overlapping pressure treated wood planks over full length of ducts.
- .9 Place continuous strip of warning tape above duct (at a half depth between finished grade and duct) before backfilling trenches.
- .10 Install markers as required.