



**Public Works and
Government Services Canada**

Requisition No: _____

SPECIFICATIONS

for

Fisheries & Oceans Canada- Institute of Ocean Sciences

New Guardhouse, Sidney, BC

Project No.: F1700-204430

April 2020

APPROVED BY:

Regional Manager, AES

Date




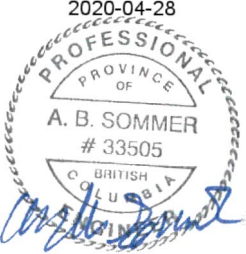

Construction Safety Coordinator

Date

TENDER:

Project Manager

Date

<p>ARCHITECTURE</p> 	<p>STRUCTURAL</p> 
<p>MECHANICAL</p> 	<p>ELECTRICAL</p> <p>DIVISION 26 ELECTRICAL DIVISION 27 COMMUNICATIONS DIVISION 28 ELECTRONIC SAFETY AND SECURITY DIVISION 7 SECTION 07 84 00 ONLY DIVISION 33 SECTION 33 65 76 ONLY</p> <p>2020-04-28</p> 
<p>CIVIL</p> 	

END OF SECTION

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Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises general construction of a guardhouse with all connections of its utilities, located at The Institute of Ocean Sciences in 9860 West Saanich Road V8L 5T5 Sidney, BC; and further identified as The Guardhouse.

1.2 CONTRACT METHOD

- .1 Construct Work under Stipulated Price Contract, CCDC-2.

1.3 DESCRIPTION OF WORK

- .1 New 59 m² one-storey Guardhouse.
- .2 The Work includes, but is not limited to, the following general scope;
 - .1 Site Demolition, Excavation, & Preparation, to suit the new Work
 - .2 Architectural, Structural, Mechanical & Electrical: construction of the new Guardhouse.
 - .3 Civil: new associated site services, and retaining walls, curbs, paving and sidewalks;
 - .4 Landscaping: re-grading, re-sodding and planting, materials and labour. (\$5000.00)
- .3 Include all temporary means and facilities required to advance the work in a timely manner, and to keep the property protected, safe and secure during the performance of the work. Refer to all Division 1 measures.
- .4 Contractor Staging Area and Access to the Site: refer to Site Plan and Division 1 requirements.

1.4 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to the Departmental Representative, in writing, any defects which may interfere with proper execution of Work.
- .3 Work of Project executed prior to start of/during Work of this Contract, and which is specifically excluded from this Contract:
 - .1 Security Fencing, Vehicle Gate and Traffic Control Gates.
- .4 Work of Project which will be executed after or during completion of Work of this Contract, and which is specifically excluded from this Contract:

.1 A fire alarm system will be installed in this building and linked to the rest of the facility as part of a future project. Rough-in for devices and equipment to be installed in the walls is included in this project.

.5 Work of this Project must include provisions for co-ordinating related work, also identified in Contract Documents, for following principal items.

.1 Immediately adjacent Work, Security Fence and Gates.

1.5 WORK SEQUENCE

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

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

.3 Maintain fire access/control.

.4 Refer to Section 01 52 00 Construction Facilities for road access limitations.

1.6 CONTRACTOR USE OF PREMISES

.1 Unrestricted use of site until Substantial Performance, road access subject to Section 01 52 00 Construction Facilities.

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

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

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

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

1.7 OWNER OCCUPANCY

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

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

1.8 OWNER FURNISHED ITEMS

.1 Owner Responsibilities:

.1 Owner to provide Hand towel Dispenser

.2 Owner supplied cabinets as per Schedule on A2.10.

Contractor to remove cabinets from existing Guardhouse.

1.9 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.10 EXISTING SERVICES

- .1 Notify, the Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 5 working days notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.
- .3 Provide alternative routes for personnel, pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify the Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by the Departmental Representative to maintain critical building and tenant systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise the Departmental Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers in accordance with Section 01 52 00 – Construction Facilities.

1.11 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Provide sanitary facilities for the work force in accordance with governing regulations and ordinances. Remove temporary facilities from site when directed by the DFO Contract Administrator.
- .5 Use only assigned elevators, stairwells, or paths of travel in existing in building for moving workers and material.
- .6 Closures: protect work temporarily until permanent enclosures are completed.
- .7 Workers shall refrain from use of loud and vulgar language. Non- compliance to this policy will result in the specific worker(s) involved being required to immediately leave the site and to be permanently removed from any subsequent involvement on this project by the Contractor.
- .8 Use of loud radios shall be prohibited.
- .9 Pets are not allowed on site.
- .10 Vehicles must be parked in designated areas.
- .11 The Departmental Representative will designate storage areas for tools and equipment.
The Contractor shall assign and coordinate storage facilities for sub-Contractors within these designated areas

1.2 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING SYSTEMS

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

1.3 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.

- .2 Where Work involves breaking into or connecting to existing services give Departmental Representative Consultant a minimum of 5 working days of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel and pedestrian and vehicular traffic.
- .4 Construct barriers in accordance with WorkSafeBC, safety authority, Authority Having Jurisdiction, and Departmental Representative.

1.4 SPECIAL REQUIREMENTS

- .1 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .2 Keep within limits of work and avenues of ingress and egress.

1.5 TRENCHING AND EXCAVATION

- .1 Two First Nations Cultural Observers must be present during all excavation within the IOS property. Coordinate attendance of observers with the First Nation.
 - .1 Costs for observers shall be paid directly by the contractor to the local first nation
 - .2 Costs for Cultural Observers are \$30/hr for each observer.

1.6 Security

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting five days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within [three] days after meetings and transmit to meeting participants and Departmental Representative.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Establish time and location of meeting and notify parties concerned minimum 10 days before meeting.
- .3 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.07 - Construction Schedule - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittals.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section Section 01 52 00 - Construction Facilities.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .8 Owner provided products.
 - .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

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

1.3 PROGRESS MEETINGS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittals

1.2 DEFINITIONS

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

1.3 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate, as defined times of completion, are of essence of this contract.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittals.
- .2 Submit to Departmental Representative within 15 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to the Departmental Representative within 10 working days of receipt of acceptance of Master Plan.

1.5 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Project completed before **October 31, 2020**.

1.6 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

1.7 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Pile Driving
 - .6 Project Completion

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 Section Includes

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.2 Precedence

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

1.3 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work is co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.4 SUBCONTRACTOR LIST

- .1 Submit list of all subcontractors including contact information to Departmental Representative within 10 business days of contract award.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Refer to CCDC-2 (2008) GC 3.11.
- .2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .3 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.
- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .5 Allow 2 days for Departmental Representative's review of each submission.
- .6 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .7 Make changes in shop drawings as Departmental Representative require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions, other than those requested.
- .8 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .9 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.

- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .10 After Departmental Representative's review, distribute copies.
- .11 Submit electronic copies of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .12 Submit electronic copies of product data sheets or brochures for requirements requested in specification sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .13 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product, or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .14 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system, or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .15 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.

- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .16 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings. Responsibility for which shall remain with Contractor submitting, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.6 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to the Owner.
- .3 Notify the Owner 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 the Owner are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Owner prior to proceeding with Work.
- .6 Make changes in samples, which the Engineer may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.7 MOCK-UPS

- .1 Not used.

1.8 PROGRESS PHOTOGRAPHS

- .1 Submit progress photographs in accordance as requested by the Departmental Representative

1.9 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.
- .3 Compliance certificates, material and product certificates shall be maintained in the document of compliance records.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

- .1 Not Used.

END OF SECTION

Part 1 General

PWGSC Update on Asbestos Use

Effective April 1, 2016, all Public Works and Government Services of Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials.

COVID 19

All contractors shall follow Canadian Construction Association COVID-19 - Standardized Protocols for All Canadian Construction Sites, Appendix C.

1.1 References

- .1 Canada Labour Code, Canada Occupational Safety and Health Regulations.
- .2 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .3 Canadian Standards Association (CSA):
 - .1 CSA S269.1-1975 (R1998), Falsework for Construction Purposes.
 - .2 CSA S269.2-M87 (R1998), Access Scaffolding for Construction Purposes.
 - .3 CSA S350-M1980 (R1998), Code of Practice for Safety in Demolition of Structures.
- .4 Fire Commissioner of Canada (FCC):
 - .1 FCC No. 301-1982, Standard for Construction Operations.
 - .2 FCC No. 302-1982, Standard for Welding and Cutting.
- .5 National Building Code of Canada (NBC):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .6 Province of British Columbia:
 - .1 Workers Compensation Act (Occupational Health & Safety), Amendment Act, BC Reg. 185/99, herein referred to as the Workers Compensation Act (WCA).

1.2 Related Sections

- .1 Refer to the following sections as required:
 - .1 Submittals Section 01 33 00

1.3 Workers Compensation Board Coverage

- .1 Comply fully with the Work Safe BC regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is

issued.

1.4 Compliance with Regulations

- .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

- .1 Perform submittals, if required in accordance with Section 01 33 00
- .2 The following shall be in the Records Document:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by federal and provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .3 Records of Health and Safety Plan, and any revised version, to the Owner is to be a part of the Records Document and It shall not:
 - .1 Be construed to imply approval by the Owner.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 Responsibility

- .1 Be responsible for:
 - .1 The safety of persons and property on site; and
 - .2 The protection of persons off site, and the environment to the extent that they may be affected by the conduct of the work.

1.7 General Protection

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
- .3 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

- .4 Secure site at night time or provide security guard as deemed necessary to protect site against entry.

1.8 Regulatory Requirements

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provisions of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Engineer will advise on the course of action to be followed.

1.9 Work Permits

- .1 Obtain all necessary permits related to the project before start of work.

1.10 Health and Safety Plan

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a job-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work procedures.
 - .6 Inspection policy and procedures
 - .7 Incident reporting and investigation policy and procedures
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings
 - .10 Occupational Health and Safety communications and record keeping procedures.
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work.
 - .4 Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
 - .5 Identify personal protective equipment (PPE) to be used by workers.

- .6 Identify personnel and alternates responsible for site safety and health.
- .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all sub-contractors. Ensure that work/activities of sub-contractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Engineer.

1.11 Emergency Procedures

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Engineer and site staff.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .5 Notify Engineer and staff.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 At least once each year, emergency drills must be held to ensure awareness and effectiveness of emergency exit routes and procedures, and a record of the drills must be kept.
- .6 Revise and update emergency procedures as required, and re-submit to the Engineer.

1.12 Meetings

- .1 Contractor to hold health and safety meetings related to execution of the work for the float module on his designated facility.

1.13 Health and Safety Officer

- .1 The Health and Safety Officer must:
 - .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
 - .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
 - .3 Be on site during execution of work.

1.14 Hazardous Products

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Engineer and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Obtain appropriate permission beforehand of the product(s) intended for use.
 - .2 Submit applicable MSDS and WHMIS documents as per Section 01 33 00.
 - .3 Provide adequate means of ventilation in accordance with WCB of British Columbia.

1.15 Removal of Lead-Containing Paints

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

1.16 Electrical Safety Requirements

- .1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
- .2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.17 Electrical Lock-out

- .1 Develop, implement and enforce use of established procedures to provide electrical lock-out and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lock-out procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have the procedures available for review upon request by the Owner.
- .3 Keep the documents and lock-out tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Owner or by any authorized safety representative.

1.18 Overloading

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

1.19 Falsework

- .1 Design and construct falsework in accordance with CSA S269.1.

1.20 Scaffolding

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CAN/CSA-S269.2.

1.21 Confined Spaces

- .1 Carry out work in confined spaces in compliance with provincial regulations.

1.22 Blasting

- .1 Not Required.

1.23 Powder-Actuated Devices

- .1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Engineer.

1.24 Fire Safety Requirements

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.25 Fire Protection and Alarm Systems

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed.
 - .2 Shut off.
 - .3 Left Inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department and the building owner and tenants, resulting from false alarms.

1.26 Posted Documents

- .1 Post legible versions of the following documents on site:
 - .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Drawing showing project layout, locations of the first aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Floor plans
 - .6 Notice as to where a copy of the workers' Compensations Act and Regulations are available on the work site for review by employees and workers.
 - .7 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .8 Material Safety Data Sheets (MSDS).
 - .9 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

1.27 Correction of Non-Compliance

- .1 Immediately address health and safety non-compliance issues as directed by the appropriate regulators.
- .2 Record action taken to correct non-compliance with health and safety issues identified by the appropriate regulators.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 INSPECTION

- .1 Refer to CCDC-2 (2008), GC 2.3.
- .2 Allow Departmental Representative or Consultant Engineer access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative or Consultant Engineer instructions, or law of Place of Work.
- .4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .5 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.3 ACCESS TO WORK

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

1.4 PROCEDURES

- .1 Notify Departmental Representative or Consultant Engineer 5 days in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

- .1 Refer to CCDC-2, GC 2.4.
- .2 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative or Consultant Engineer as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 If in opinion of Departmental Representative or Consultant Engineer it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative and Consultant Engineer,

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC-2 (2008), Stipulated Price Contract.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-M1978(R2003), Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.
- .4 Public Works Government Services Canada (PSPC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .5 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 INSTALLATION AND REMOVAL

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

1.3 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.

1.4 HOISTING

- .1 Provide, operate and maintain hoists [cranes]required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

- .2 Hoists [cranes]to be operated by qualified operator.

1.5 SITE STORAGE/LOADING

- .1 Refer to CCDC-2, GC 3.12.
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- .1 Parking will not be permitted on site. Arrangements as follows:
 - .1 Parking available for the Contractor; sub contractors will require a visitor pass.
 - .2 Parking area near loading bay and large generator.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

1.7 OFFICES

- .1 Contractor to provide temporary office facilities on premises, location as directed by the Departmental Representative.
- .2 Subcontractors to provide their own offices as necessary, location as per Departmental Representative.
- .3 Provide marked and fully stocked first-aid case in a readily available location.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.9 SANITARY FACILITIES

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

1.10 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by the Departmental Representative.

- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads.
Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.11 CLEAN-UP

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section

1.2 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC-2 (2008), Stipulated Price Contract.

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

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

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

.5 Cost for such testing will be born by the Departmental Representative in event of conformance with Contract Documents or by the Contractor in event of non-conformance.

1.3 WARRANTY

.1 Where the contractor supplies equipment purchased from a contractor manufacturer, the Contractor shall obtain from the Manufacturer the normal warranty period and such warranty shall be made out to Her Majesty the Queen in right of Canada.

1.4 QUALITY

.1 Refer to CCDC-2.

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

.3 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

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

- .5 Should disputes arise as to quality or fitness of products, decision rests strictly with [Departmental Representative] based upon requirements of Contract Documents.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .7 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.

1.5 AVAILABILITY

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

1.6 STORAGE, HANDLING AND PROTECTION

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

1.7 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by the Departmental Representative. Unload, handle and store such products.

1.8 MANUFACTURER'S INSTRUCTIONS

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

1.9 QUALITY OF WORK

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

1.10 CO-ORDINATION

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

1.11 CONCEALMENT

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

1.12 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

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

1.13 LOCATION OF FIXTURES

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

1.14 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.15 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.16 PROTECTION OF WORK IN PROGRESS

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

1.17 EXISTING UTILITIES

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

- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify the Departmental Representative of findings.
- .2 Minimal documentation is available showing location of existing underground services. Buried services on the site include but are not limited to water, sewer, high voltage (25kV) distribution, low voltage (600 and 208V) distribution, and communications systems.
- .3 Perform Ground Penetrating Radar scans of all areas to be excavated and/or where equipment is to be installed outdoors prior to commencing Work.

1.2 LOCATION OF EQUIPMENT AND FIXTURES

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

1.3 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Contractor performing Ground Penetrating Radar scans to the Departmental Representative.
- .2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

1.5 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative and Consultants in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

- .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on site, unless approved by the Departmental Representative.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Dispose of waste materials and debris off site.
- .5 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .6 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .7 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

- .1 Refer to CCDC-2, GC 3.14.
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .5 Remove waste products and debris including that caused by Owner or other Contractors.

- .6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with the Departmental Representative to review and discuss waste management goals and Contractor's Waste Reduction Workplan.
- .2 Waste Management Goal is to divert all materials considered recyclable from landfill sites.
- .3 Target percentage goals are achievable for waste diversion. Contractor to review and confirm the Departmental Representative's Waste Audit acceptable values.
- .4 Minimize amount of non-hazardous solid waste generated by project and accomplish maximum source reduction, reuse and recycling of solid waste.
- .5 Protect environment and prevent environmental pollution damage.

1.2 DISPOSAL OF WASTES

- .1 Debris and waste will be managed and disposed of in a proper manner as approved by the Departmental Representative. Permits for waste handling and disposal will be obtained by the Contractor. Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Reused or recycled waste destination.
- .4 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in the waste audit.

1.3 SCHEDULING

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

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

3.2 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify the Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request the Departmental Representative Inspection.
- .2 Departmental Representative Inspection: the Departmental Representative, Consultant and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and are fully operational.
 - .4 Operation of systems have been demonstrated to Owner's personnel.
 - .5 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by the Departmental Representative and Engineer Consultant. If Work is deemed incomplete by the Departmental Representative and Engineer Consultant, complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Owner and the Departmental Representative and Engineer consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance. Refer to CCDC 2, General Conditions Article DOC 14 DOC 15 for specifics to application.
- .6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance shall be dated for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

- .7 Final Payment: when the Owner and the Departmental Representative consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. Refer to CCDC-2. If Work is deemed incomplete by the Owner, the Departmental Representative, and the Consultant, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount in accordance with CCDC-2.

1.3 CLEANING

- .1 In accordance with Section 01 74 11 - Cleaning.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 77 00 Closeout Procedures

1.2 REFERENCES

- .1 Canadian Environmental Protection Act (CEPA)

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

1.5 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

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

1.6 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.7 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, [in addition to requirements in General Conditions, at site for the Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.

- .8 Manufacturer's certificates.
- .2 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .3 Keep record documents and samples available for inspection by the Departmental Representative.

1.8 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of drawings.
- .2 Use felt tip marking pens.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.9 EQUIPMENT AND SYSTEMS

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

- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Include manufacturer's printed operation and maintenance instructions.
- .7 Include sequence of operation by controls manufacturer.
- .8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .9 Provide installed control diagrams by controls manufacturer.
- .10 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .11 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Additional requirements: as specified in individual specifications sections.

1.11 MAINTENANCE MATERIALS

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

- .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to location as directed; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.12 DELIVERY, STORAGE AND HANDLING

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

1.13 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Warranty management plan to include required actions and documents to assure that the Departmental Representative receives warranties to which it is entitled.
- .3 Submit, warranty information made available during construction phase, to the Departmental Representative.
- .4 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, commissioned systems, fire protection, alarm systems, sprinkler systems, lightning protection systems.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.

- .3 Location where installed.
- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .5 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .6 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against the Contractor.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 General Instructions Section 01 11 00

1.2 REFERENCES

- .1 CAN/CSA- A3000-13 Cementitious Material Compendium.
- .2 CAN/CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction
- .3 CAN/CSA-A23.2-14, Test Methods and Standard Practices for Concrete
- .4 ASTM C260-10, Standard Specification Air Entraining admixtures for Concrete
- .5 ASTM C494/C494M-08a, Standard Chemical Admixtures for Concrete
- .6 ASTM D1751-04. Specification for Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- .7 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .8 ANSI/ACI 315-99, Details and detailing of Concrete Reinforcement
- .9 CSA G30.3-M1983(R1998), Cold Drawn Steel wire for Concrete Reinforcement
- .10 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement
- .11 CSA G30.18-09, Billet Steel Bars for Concrete Reinforcement
- .12 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .13 CSA0121-08(R2013), Douglas Fir Plywood
- .14 CSA 0151-09 Canadian Softwood Plywood
- .15 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC Version 1.0-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

1.3 SUBSTITUTES

- .1 Substitution of different size bars permitted only upon written approval of Departmental

Representative.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Instructions.

Part 2 PRODUCTS

2.1 CONCRETE MATERIALS

- .1 Cement: to CAN/CSA- A3000.
- .2 Water, fine aggregates, normal density coarse aggregates: to CAN/CSA-A23.1
- .3 Air entraining admixture: to CAN/CSA-23.1
- .4 Chemical admixtures: to CAN3-A266.1 as approved by Departmental Representative
- .5 Shrinkage compensating cementitious grout: consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agent
 - .1 compressive strength: 50MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
 - .4 Dry pack to manufacturer's requirements.
- .6 Surface sealers:
 - .1 Exterior Pavement areas: to ASTM C309 Liquid Membrane-Forming Compounds for curing Concrete, Type 1
- .7 Coloured hardener: natural, mineral aggregate type, non-metallic and colour dry shake surface hardener for wear and abrasion resistance, durable to freeze/thaw cycle and de-icing salts, minimize surface dusting and resistant to oil and grease penetration
- .8 Patching compound: cementitious based premixed compound purpose made for patching concrete

2.2 FORMWORK MATERIALS

- .1 Formwork Lumber: plywood and wood formwork materials to CAN/CSA-A23.1.
- .2 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form

- .3 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface

2.3 REINFORCING MATERIALS

- .1 Reinforcing bars: billet steel, grade 400R, deformed bars to CAN/CSA G30.18 as indicated.
- .2 Welded steel wire fabric: CSA G30.5. Provide in flat sheets only
- .3 Chairs, bolsters, bar supports, spacers: adequate for strength and support of reinforcing construction conditions

2.4 CONCRETE ACCESSORIES

- .1 Polyethylene dampproof membrane:
 - .1 To CAN/CGSB-51.34, 0.15 mm polyethylene film
 - .2 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by polyethylene film manufacturer, 50 mm wide for lap joints and perimeter seals
- .2 Premoulded joint fillers:
 - .1 Bituminous impregnated fibre board: to ASTM D1751

2.5 CONCRETE MIXES

- .1 Proportion normal density concrete to CAN/CSA A23.1, Clause 4, Alternative 1 using Type GU or GUb General use cement for concrete performance characteristics as indicated on the drawings
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CAN/CSA A23.1, Clause 4. Site mixing equipment, truck or stationary type to conform to CAN/CSA A23.1
- .3 Obtain Departmental Representative's approval before using chemical admixtures other than those specified
- .4 Use of Calcium chloride not permitted.

2.6 REINFORCING STEEL FABRICATION

- .1 Fabricate reinforcing to CAN/CSA A23.1
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on steel placing drawings.
- .3 Fabricate steel bar or rod mats welded together to CSA G30.5 using bars to CSA G30.18 grade 400.

Part 3 EXECUTION

3.1 WORKMANSHIP

- .1 Obtain Departmental Representative's approval before placing concrete. Provide forty-eight (48) hours notice to approved concrete testing agency prior to placing of concrete.
- .2 Place concrete in accordance with CAN/CSA A23.1, Clause 7.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather, prior to placing of concrete
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by Departmental Representative.
- .7 Pumping of concrete is permitted only after approval of equipment and mix.
- .8 Anchor bolts/dowels
 - .1 Use templates to place anchor bolts and dowels to tolerance associated with equipment or materials to be secured. Ensure anchor bolts and dowels remain vertical during concrete placing and finishing
 - .2 With Departmental Representative's approval, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be at least 100 mm in diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used.
 - .3 Protect anchor bolt holes from water accumulations
 - .4 Set bolts and fill holes with shrinkage compensating grout
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to temperature at time of erection

3.2 FORMWORK INSTALLATION

- .1 Verify lines, levels and wall locations before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated with tolerances required by CAN/CSA A23.1
- .3 Leave framework in place for following minimum periods of time after placing concrete
 - .1 Two days for sides of foundation walls and footings
- .4 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1. Contractor shall be responsible for design, engineering and construction of formwork

3.3 INSERTS

- .1 Set sleeves, ties anchor bolts and other inserts, openings and sleeves, in concrete floors and foundation walls, as required by other trades. Sleeves, openings, etc. greater than 100 x 100 mm not indicated on structural drawings must be approved by Departmental Representative.

- .2 Check locations and sizes of sleeves, openings, etc. shown on structural drawings with architectural, mechanical and electrical drawings.
- .3 If inserts cannot be located as specified, obtain approval of all modifications from Departmental Representative before placing of concrete

3.4 JOINT FILLERS

- .1 Locate and form isolation joints as indicated. Install joint filler to manufacturer's instruction.
- .2 Unless otherwise indicated, use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces. Extend joint filler from bottom of slab to within 12 mm of finished slab surface.
- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalks coincide.
- .4 Locate expansion joints in concrete slabs on grade. Fibreboard joints minimum 6 mm thickness.

3.5 DAMPROOF MEMBRANE

- .1 Install damproof membrane under concrete slabs within building, lap 150 mm at joints and seal with mastic cement or tape.
- .2 Seal punctures using damproof membrane material extending 150 mm past all punctures and sealed with mastic cement or tape.

3.6 PLACING REINFORCEMENT

- .1 Place reinforcing steel to CAN/CSA A23.1
- .2 Obtain Departmental Representative's approval of reinforcing steel and placing before concrete.
- .3 Clean reinforcing before placing concrete
- .4 When field bending of reinforcement is approved by Departmental Representative, bend without heat, applying slow and steady pressure.

3.7 FINISHING

- .1 Finish concrete to CAN/CSA A23.1, Clause 7. Slope floor to drains or perimeter openings.
- .2 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise detailed.
- .3 Equipment pads: smooth troweled surface

- .4 Exterior paving: finish as per Clause 3.10, Para. .2 and .3.

3.8 DEFECTIVE CONCRETE

- .1 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
- .2 Fill all honeycombing or voids flush with adjoining surfaces.

3.9 PLAIN FLOOR FINISH

- .1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed.
- .2 Float surface with metal floats or with power finishing machine to bring surface to true grade.
- .3 Apply coloured hardener to floor slabs where scheduled (CH & S) in accordance with manufacturer's written instructions. Apply in two (2) shakes at a maximum rate of 4 to 5 kg/m²
- .4 Steel trowel to smooth and even surface.
- .5 Follow with second steel towelling to produce burnished surface to within 3 mm tolerance when measured in any direction using 3 m straight edge.
- .6 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.
- .7 Saw cut crack-control joints to CAN/CSA A23.1, Clause 7.3.2 or use removable plastic insert strips.
- .8 After curing and when concrete floors are dry, seal control joints at junction with vertical surfaces with a self-levelling oil resistant sealing compound.

3.10 INSPECTION AND TESTING

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative.
- .2 Costs for testing will be borne by the contractor.
- .3 Arrange with testing laboratory to do site testing from each batch of concrete placed or for each major days pour as designated by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

Submittal Procedures

Section 01 33 00

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A 36/A 36M-14, Specification for Structural Steel.
 - .2 ASTM A307-12, Specification for Carbon Steel Bolts and Studs, 60,000psi Tensile.
 - .3 ASTM A325-10e1, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .4 ASTM A 325M-13, Specification for High-Strength Bolts for Structural Steel Joints.
- .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA).
 - .1 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.
 - .2 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20-13, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA-G40.21-13, Structural Quality Steels.
 - .3 CAN/CSA-G164-M92 (withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CAN/CSA-S16-14, Design of steel structures
 - .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
 - .6 CSA W48-14, Electrodes.
 - .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).

1.3 DESIGN REQUIREMENTS

- .1 All structural steel connections shall be designed by the contractor for forces, moments and shears resulting from the specified load and self weight of the supporting elements and all forces as shown on the drawings, unless noted otherwise. All main connection bolts shall be minimum M20. Use minimum two bolts per connection. All welds shall have 6mm leg minimum.
- .2 If connection for shear only (standard connection) is required:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction".

.3 If shears are not indicated, select or design connections to support reaction from 120% maximum uniformly distributed load that can be safely supported by beam in bending (60% each end), provided no point loads act on beam.

.4 Provide splices as indicated on drawings. Unless noted otherwise, all continuous elements called up on the drawings shall be provided with full strength splice either by full strength groove weld or by full strength splice plates on each end of the connection elements.

1.4 SHOP DRAWINGS

.1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00 – Submittal Procedures. Shop drawings for anchor bolt layout and embedded plate layout shall also be submitted for review.

.2 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.

.3 No fabrication or work shall be commenced until the review and approval of the shop drawings. The contractor shall assume full responsibility for any fabrication and work done prior to review and approval of the shop drawings.

.4 Contractor shall co-ordinate and verify all dimension and locations prior to production of the drawing.

.5 All fabricator designed assemblies, components and connections, and drawings to be stamped and signed by qualified professional engineer licensed in the British Columbia, Canada.

.6 The Professional Engineer responsible for the shop drawings shall inspect the installation of the work for conformance with the design and the shop drawings, and shall upon completion of the work submit to the Consultant a completed Schedule S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional.

1.5 QUALITY ASSURANCE

.1 Submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work at least 2 weeks prior to fabrication of structural steel. Mill test reports shall be certified by metallurgists qualified to practice in British Columbia, Canada.

.2 Fabricator of structural steel shall, in addition, provide an affidavit stating that materials and products used in fabrication conform to applicable material and products standards called for by design drawings and specifications.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Instructions.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CAN/CSA-G40.21 Grade as indicated on drawings.
- .2 Anchor bolts: ASTM A307 unless noted otherwise on drawings.
- .3 Bolts, nuts and washers: to ASTM A 325
- .4 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer: to CISC/CPMA 1.
- .6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Welding shall be performed by certified welders. Fabrication shops shall be approved by the Canadian welding bureau to CSA-W47.1 (Division 1 or 2). Certification shall be supplied to the Departmental Representative upon request.
- .3 Unless noted otherwise, install all rolled steel sections with mill camber upwards.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.
- .5 All areas of galvanized parts shall be grounded off prior to welding. Part 2 coats minimum of zinc rich primer read mix to CAN/CGSB-1.181 after welding.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16 except where members to be encased in concrete.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC SP7 brush off blast.
- .3 Apply one coat of CISC/CMPD2-75 primer in shop to steel surfaces to achieve minimum dry film thickness of 3 to 4 mils, except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces to receive field installed stud shear connections.

- .3 Surfaces and edges to be field welded.
- .4 Faying surfaces of friction-type connections.
- .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 EXECUTION

3.1 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59.
- .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.

3.2 CONNECTION TO EXISTING WORK

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

3.3 MARKING

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

3.4 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 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.
- .5 Install and torque all bolts and drilled anchors in accordance with manufacturer's

specifications and procedures.

- .6 Any misfit or misalignment must be reported to the Departmental Representative. The contractor shall provide proposed remedial measures to the Departmental Representative for review and approval. Any remedial work on connections must be reviewed and/or redesigned by the connection engineer. Costs of remedial work are at the expense of the contractor.
- .7 Do not notch or cut openings in any of the framing members and connection without prior approval from the Departmental Representative.
- .8 Provide temporary bracing to structure for stability and safety as required until the completion of the steel structure.
- .9 Contractor shall do welding work in strict conformance with the requirements of CSA W59, in particular, preheating requirements and welding restriction in low temperature.

3.5 FIELD QUALITY CONTROL

- .1 The Departmental Representative will not be responsible for inspection of the Contractor's work as described in Clause 7.12 of the CISC Code of Standard Practice for Structural Steel. The Contractor is responsible for the accuracy and completeness of his own work and shall verify that the structural steel has been fabricated, erected and finished in accordance with the contract specifications.
- .2 Inspection and testing of materials and workmanship will be carried out by an independent testing laboratory approved by Departmental Representative.
- .3 Testing requirements are as follows:
 - .1 Visual Field Inspection and Bolt Torque Testing (Random 10% of Bolts) of all bolted connections.
 - .2 Non Destructive Testing of Welds: 100% of all welds to be visually inspected.
- .4 Welding inspector shall be certified to CSA W178.2 Level 2 or Level 3.
- .5 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .6 Submit test reports to Departmental Representative within 1 week of completion of inspection.
- .7 Costs of tests shall be borne by the Contractor.

3.6 FIELD PAINTING

- .1 Touch up damaged surfaces and surfaces without shop coat with primer to

SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB
85.10.

END OF SECTION

Part 1 GENERAL

1.1 RELATED WORK

- .1 [Section 01 33 00 Submittal Procedures]

1.2 REFERENCE

- .1 Canadian Standards Association (CSA).
 - .1 CAN/CSA-S16-14, Design of Steel Structures.
 - .2 CSA-S136-16, North American Specification for The Design of Cold-formed Steel Structural members.
 - .3 CSA 47.1- 09, Certification of Companies for Fusion Welding of Steel.
 - .4 CSA 55.3-08 (R2013), Certification of companies for resistance welding of steel and aluminum.
 - .5 CSA W59- 03, Welded Steel Construction, (Metal Arc Welding).
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.181- 99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 American Society for Testing and Materials (ASTM).
 - .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 A792/A 792M-10 (2015), Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .4 Canadian Sheet Steel Building Institute (CSSBI).
 - .1 CSSBI 10M- 08, Standard for Steel Roof Deck.

1.3 DESIGN REQUIREMENT

- .1 Design steel deck using limit states design in accordance with CSA S136 and, CSSBI 10M.
- .2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, and uplift as indicated.
- .3 Deflection under specified snow load not to exceed 1/360 of deck span.
- .4 Where vibration effects are to be controlled as indicated, dynamic characteristics of decking system to be designed to be in accordance with CAN/CSA-S16, Annex 'E'.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings erection and shoring drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .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 spacing, projections, openings, reinforcement and accessories.
- .5 All steel deck design drawings to be stamped and signed by qualified professional engineer licensed in the British Columbia, Canada.
- .6 The Professional Engineer responsible for the shop drawings shall inspect the installation of the work for conformance with the design and the shop drawings, and shall upon completion of the work submit to the Consultant a completed Schedule S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional.

Part 2 PRODUCTS

2.1 MATERIAL

- .1 Zinc (Z) coated steel sheet: to ASTMA653/A653M structural quality Grade 230, with Z275, coating, regular spangle surface, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.91mm minimum base steel thickness.
- .2 Zinc-iron Alloy (ZF) coated steel sheet: to ASTMA653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather, unpainted finish, 0.91mm minimum base steel thickness.
- .3 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
- .4 Closures: as indicated.
- .5 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm. Metallic coating same as deck material.
- .6 Primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.2 TYPE OF DECKING

- .1 Roof steel floor deck: 0.91 mm minimum base steel thickness, 38mm deep profile, non-cellular, upright embossed fluted profile, interlocking side laps.

Part 3 EXECUTION

3.1 GENERAL

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

3.2 ERECTION

- .1 Erect steel deck as indicated and in accordance with CSA S136 CSSBI 10M and in accordance with reviewed erection drawings.
- .2 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.
- .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 Temporary shoring, if required, to be designed to support construction loads and other construction equipment.
- .6 Deck edge:
All edges of steel decking shall be supported by edge angles fastened to main structural members, unless noted otherwise, use L75x75x6 at roofs.
- .7 Unless noted otherwise, all members designated as diaphragm chord members and all perimeter edge angles shall be connected by full strength groove welds or by full strength splice plates on each leg to form continuous compression and tension members. Weld edge angles and chords to Beams, joists and shear connectors and weld deck to angles chords and structural members as shown on drawings or as detailed by decking contractor.
- .8 Where possible, supply and install decking in length that will permit continuity over a minimum of three spans.

3.3 CLOSURE

- .1 Install closures in accordance with approved details.

3.4 OPENINGS AND AREAS OF CONCENTRATED LOADS

- .1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.
- .2 For larger openings, detail framing as follows:

Location	Opening Size (In any direction)	Reinforcing
Roof	<150mm but < 500mm	L51x51x6.4 running perpendicular to flutes and welded to minimum two

flutes each side of opening

Roof >500mm

L76x76x6.4 all around and extending to
supporting structural steel members

3.5 CONNECTIONS

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

3.6 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 inspection and testing on site, as required by testing agency and as authorized by Departmental Representative.
- .3 Submit test reports to Departmental Representative within 1 week of completion of inspection.
- .4 Costs of tests will be borne by Contractor.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- | | | |
|----|--------------|------------------|
| .1 | Dampproofing | Section 07 10 00 |
| .2 | Gypsum Board | Section 09 29 00 |

1.2 REFERENCES

- .1 ASTM A653/ A653M- 09, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .2 ASTM A792/ A792M- 10, Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .3 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .5 CSA W55.3-1965 (R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .6 CSA- W59-08, Welded Steel Construction (Metal Arc Welding).
- .7 CAN/CSA-S136-16, North American specification for the Cold Formed Steel Structural Members.
- .8 CAN/CGSB-1.181- 99, Ready-Mixed Organic Zinc-Rich Coating.
- .9 CSA A370-18 Connectors for Masonry.
- .10 CSA S304.1-04 Masonry Design for Buildings.
- .11 Association of Wall & Ceiling Contractors (AWCC) of British Columbia Specifications Standard Manual.
- .12 Underwriter Laboratories of Canada.

1.3 DESIGN REQUIREMENT

- .1 All steel stud connections shall be designed by the contractor for forces, moments and shears resulting from the specified loads and self weight of the supporting element and all forces as shown on the drawings, unless noted otherwise. These connections include, but not limited to gravity connections, integrity connections, bridging/bracing connections, steel stud to steel members connections, steel stud to steel stud connections and connections for the forces as specified in the drawing. Contractor shall also be responsible for the design of

- all non-loadbearing steel stud wall. Submit signed and sealed shop drawing for review and approval as per Section 1.4.
2. If shears are not indicated, select or design connections to support reaction from 120% maximum uniformly distributed load that can be safely supported by steel stud joist in bending (60% each end), provided no point loads act on steel stud joist.
 3. Provide splices as indicated on drawings. Unless noted otherwise, all continuous elements called up on the drawings shall be provided with full strength splice either by full strength groove weld or by full strength splice plates on each end of the connection elements.
 - .4 Design shall be based on Limit States Design Principles using factored loads and resistances.
 - .5 Loads and load factors shall be determined in accordance with the 2015 National Building Code of Canada.
 - .6 Resistances and resistance factors shall be determined in accordance with the National Building Code and CSA - S136.
 - .7 Conform to the requirements of specified fire rated assemblies.
 - .8 Steel studs up to 152mm deep shall have a minimum design thickness of 0.84mm (0.033") and studs deeper than 152mm shall have a minimum design thickness of 1.12mm (0.044").
 - .9 Provide bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress effects due to the torsion between lines of bridging. The minimum design thickness for bridging channels shall be 1.22mm. Do not rely on sheathing to resist torsion or minor axis buckling.
 - .10 Maximum deflection under specified loads shall be L/360.
 - .11 Design components or assemblies to accommodate specified erection tolerances of the structure and for local loading due to anchorage of cladding and wall mounted fixtures where shown.
 - .12 The spacing of wall studs shall not exceed 600 mm o.c.
 - .13 Connections between lightweight steel framing members shall be by bolts, welding or sheet metal screws.
 - .14 Resistances for sheet metal screws shall be calculated in accordance with Equations E4.3 to E4.5 inclusive in CSA - S136. Block tear out of a group of fasteners shall be checked in accordance with clause E5.

- .15 Anchor the top and bottom top and bottom tracks to the structure at a maximum spacing of 800mm. Closer spacing may be required to satisfy structural requirements.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Shop Drawings, Product data & Samples.
- .2 Indicate design loads, member sizes, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes and spacing, and anchors. Provide product data for mechanical fasteners indicating sizes, load capacities and type of corrosion protection.
- .3 All fabricator designed assemblies, components and connections, and drawings to be stamped and signed by qualified professional engineer licensed in the province of British Columbia, Canada.
- .4 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.
- .5 Indicate locations, dimensions, openings and requirements of related work.
- .6 Indicate welds by welding symbols as defined in CSA W59.
- .7 No fabrication or work shall be commenced until the review and approval of the shop drawings. The contractor shall assume full responsibility for any fabrication and work done prior to review and approval of the shop drawings.
- .8 Contractor shall co-ordinate and verify all dimension and locations prior to production of the drawing.
- .9 Each shop drawing submitted shall bear the stamp and signature of a qualified Professional Engineer registered in the Province of British Columbia.
- .10 Submit design calculations if requested by Departmental Representative.
- .11 The Professional Engineer responsible for the shop drawings shall inspect the installation of the work for conformance with the design and the shop drawings, and shall upon completion of the work, provide to the Departmental Representative completed Schedules S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional.

1.5 SAMPLES

- .1 Submit samples and shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product data & Samples.
- .2 Submit samples of framing components and fasteners to Departmental Representative if requested.

1.6 QUALITY ASSURANCE

- .1 Submit 2 copies of mill test reports showing chemical and physical properties and other details of structural metal steel stud to be incorporated into work at least 2 weeks prior to fabrication of structural metal steel stud. Mill test reports shall be certified by metallurgists qualified to practice in British Columbia, Canada.
- .2 Fabricator of structural metal steel stud shall, in addition, provide an affidavit stating that materials and products used in fabrication conform to applicable material and products standards called for by design drawings and specifications.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management and Disposal].

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Steel: to CAN/CSA-S136, Grade 230 or 345
- .2 Zinc (Z) coated steel sheet: to ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated or Zinc-Iron Alloy-Coated by the Hot-Dip Process.
- .3 Aluminum-zinc alloy (AZ) coated steel sheet: to ASTM A 792/A 792M Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .5 Screws: pan head, self-drilling, self-tapping sheet metal screws, corrosion protected with a minimum coating thickness of 0.008mm of zinc or cadmium.
- .6 Anchors: concrete expansion anchors or other suitable drilled type fasteners. Powder actuated / low velocity fasteners to either concrete or steel are not permitted.
- .7 Bolts, nuts, washers: hot dipped galvanized to CAN/CSA-G164, 600 g/m² zinc coating.
- .8 Touch up primer: zinc rich, to CGSB 1-GP-181M.

2.2 STEEL STUD DESIGNATIONS

- .1 Colour code steel studs for gauge in accordance with AWCC colour code chart.

2.3 METAL FRAMING

- .1 Steel studs: to CAN/CSA S-136, fabricated from zinc coated steel, depth as indicated on the shop drawings. Minimum steel thickness of 0.91mm unless otherwise as shown on structural drawings.
- .2 Stud tracks: fabricated from same material and finish as steel studs, depth to suit.
 - .1 Bottom track: single piece.
 - .2 Top track: two piece telescoping.
 - .3 Separator: neoprene, sized to suit.
- .3 Bridging: fabricated from same material and finish as studs, 1.22 mm minimum thickness.
- .4 Angle clips: fabricated from same material and finish as studs, depth of angle to match depth of steel stud, 1.22 mm minimum thickness.
- .5 Tension straps and accessories: as recommended by manufacturer.

2.4 SOURCE QUALITY CONTROL

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

Part 3 EXECUTION

3.1 GENERAL

- .1 Do welding in accordance with CSA W59.
- .2 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.
- .3 Do work in accordance with CSSBI 51M.

3.2 ERECTION

- .1 Erect components to requirements of reviewed shop drawings.
- .2 Anchor tracks securely to structure at 800 mm o.c. maximum, unless lesser spacing prescribed on shop drawings.

- .3 Erect studs plumb, aligned and securely attached with 2 screws minimum, or welded in accordance with manufacturer's recommendations.
- .4 Seat studs into bottom tracks and two-piece telescoping top track.
- .5 Install 50.0 mm minimum telescoping track at top of walls where required to accommodate vertical deflection. Nest top track into deflection channel a minimum of 30.0 mm and a maximum of 35.0 mm. Do not fasten tracks together. Stagger joints and install neoprene separator.
- .6 Install studs at not more than 50.0 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .7 Brace steel studs with horizontal internal bridging at 1220mm maximum. Fasten bridging to steel clips fastened to steel studs with screws or by welding.
- .8 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.
- .9 Touch up welds with coat of zinc rich primer.

3.3 ERECTION TOLERANCES

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

3.4 CUTOUTS

- .1 Maximum size of cut-outs for services as follows:

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

- .2 Cut-out locations and size shall be submitted to the Departmental Representative for approval prior to any cutting. No cut-out shall be allowed through the built-up studs unless approved by the Departmental Representative.
- .3 Limit distance from centerline of last un-reinforced cutout to end of member to less than 300 mm.

3.5 FIELD QUALITY CONTROL

- .1 The Departmental Representative will not be responsible for inspection of the Contractor's work for Structural Metal Stud. The Contractor is responsible for the accuracy and completeness of his own work and shall verify that the structural metal stud has been fabricated, erected and finished in accordance with the contract specifications.
- .2 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .3 Testing requirements are as follows:
 - .1 Non Destructive Testing of Welds: 100% of all welds to be visually inspected.
- .4 Welding inspector shall be certified to CSA W178.2 Level 2 or Level 3.
- .5 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .6 Submit test reports to Departmental Representative within 1 week of completion of inspection.
- .7 Costs of tests shall be borne by the Contractor.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Galvanized Steel Curtain Wall Support Angles.
- .2 Galvanized Metal Handrails and Guardrail.
- .3 Exterior Condensing Unit (Unistrut).
- .4 Other Metal Work

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 269 08, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated Welded and Seamless.
 - .3 ASTM A 307-07v, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .5 ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- .2 CSA International
 - .1 CSA G40.20/G40.21-04 (R2009), 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 S16-09, Design of Steel Structures.
 - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) [Metric].
 - .1 GS-11-2008, 2nd Edition], Paints and Coatings.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
- .5 Green Seal Environmental Standard GS 03 (anti-corrosive primer).

1.3 SUBMITTALS

- .1 Submit in accordance with Division 1.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Division 1.
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia. Submit Letter of Assurance Schedule B1, B2 and C-B.
 - .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 & HANDLING

- .1 Deliver, store and handle materials in accordance with Division 1 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Division 1.
- .5 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Division 1.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Bolts and anchor bolts: to ASTM A 307.
- .5 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

- .6 Aluminum: to ASTM B209, clear anodized finish.
- .7 Grout: non-shrink, non-metallic flowable, 15MPC at 24 hours.
- .8 Security fasteners: screws and bolts with spanner type heads to prevent removal except with special tools; non-corrosive type.
- .9 Shop coat primer: to CAN/CGSB-1.40M.
- .10 Galvanize touch-up primer: zinc rich, read mix to CGSB-1-GP-181M.
- .11 Pedestal roof Anchors: Stainless steel rotatable head weld-in place roof anchors, to suit BC Work Safe regulations. An example of an acceptable product is Type C from Atlas Anchor Systems.

2.2 FABRICATION

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

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 610 g/m² to CAN/CSA-G164.
- .2 Shop coat primer: CGSB 1GP 40M in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast specification SSPC-SP10.
- .3 Zinc primer: To CGSB 1GP 48, CISC/CPMA 1-73A, CISC/CPMA 2-75 in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast SSPC-SP10.

2.4 ISOLATION COATING

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

2.5 SHOP PAINTING

- .1 Primer: VOC limit 250 g/L maximum to GC-03.
- .2 Apply one shop coat of primer to metal items, with exception of aluminum, galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
 - .4 Contractor shall verify field measurements are as shown on shop drawings prior to fabrication.

3.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such
 - .4 as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .5 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .6 Supply components for work by other trades in accordance with shop drawings and schedule.
- .7 Weld field connection.
- .8 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .9 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
- .10 Primer: maximum VOC limit 250 g/L to GC-03.
- .11 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
- .12 Primer: maximum VOC limit 250 g/L to GC-03.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 1.
 - .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 Division 1.
- .3 Waste Management: separate waste materials for recycling in accordance with Division 1.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA) (latest edition)
 - .1 ANSI/NPA A208.1 Particleboard.
- .2 ASTM International, (latest edition)
 - .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .3 ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - .4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM D 5055, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .6 ASTM D 5456, Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .7 ASTM F1667 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .3 Canadian General Standards Board (CGSB), (latest edition)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
 - .2 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 Canadian Wood Council, (latest edition)
 - .1 Wood Design Manual
 - .2 Engineering Guide for Wood Frame Construction
- .5 CSA International, (latest edition)
 - .1 CAN/CSA-A123.2, Asphalt Coated Roofing Sheets.
 - .2 CSA B111, Wire Nails, Spikes and Staples.
 - .3 CSA O86 Engineered Design in Wood
 - .4 CSA O112.9, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
 - .5 CSA O121, Douglas Fir Plywood.
 - .6 CSA O141, Softwood Lumber.
 - .7 CSA O151, Canadian Softwood Plywood.
 - .8 CSA O153, Poplar Plywood.

- .9 CSA O325, Construction Sheathing.
- .10 CAN/CSA-S406, Construction of Preserved Wood Foundations.
- .11 CAN/CSA-Z809, Sustainable Forest Management.
- .6 Forest Stewardship Council (FSC), (latest edition)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .7 National Lumber Grades Authority (NLGA), (latest edition)
 - .1 Standard Grading Rules for Canadian Lumber.
- .8 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .9 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .10 Underwriters' Laboratories of Canada (ULC), (latest edition)
 - .1 CAN/ULC-S706, Standard for Wood Fibre Insulating Boards for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Div 1- Submittal Procedures.
- .2 Product Data:
 - .1 Submit custom made hangers (see drawing 2/S105) shop drawing.
 - .2 Submit CCMC Product Evaluation Report for engineered wood products.
 - .3 Submit manufacturer's installation instructions.

1.3 SUSTAINABLE DESIGN SUBMITTALS

- .1 Upon request submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.
- .2 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants 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, laminating adhesives used in building, stating that they contain no urea-formaldehyde .
 - .3 Include MSDS sheets indicating resin type for structural composite lumber and agrifibre materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 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 materials off ground with moisture barrier at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water.
 - .3 Stack, lift, brace, cut and notch engineered lumber products in strict accordance with manufacturer's instructions and recommendations.
 - .4 Store and protect architecturally exposed lumber from nicks, scratches, and blemishes.
 - .5 Replace defective or damaged materials with new.
 - .6 Store separated reusable wood waste convenient to cutting station and work areas.

Part 2 Products

2.1 SUSTAINABILITY CHARACTERISTICS

- .1 Provide wood framing products as specified and with the following sustainability characteristics.
- .2 Lumber, Finger Jointed Lumber , I-Joists , structural composite lumber (SCL) , : to be CAN/CSA-Z809 or FSC or SFI certified.
- .3 Plywood: urea-formaldehyde free and certified to, CAN/CSA-Z809 or FSC or SFI.
- .4 Adhesives: limit 120 g/L maximum to GS-36.
- .5 Provide engineered wood products certified as meeting requirements of respective ANSI standard for formaldehyde emissions and low VOC emissions when tested in accordance with ASTM D6330.
- .6 Provide fiberboard with minimum 80 % recycled content.

2.2 STRUCTURAL FRAMING

- .1 Lumber: as shown on drawing S002, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS, are not acceptable for studs.
- .3 Structural Composite Lumber (SCL) as shown on S002 in accordance with ASTM D 5456, for following uses:
 - .1 Laminated veneer lumber (LVL): beams as indicated.
 - .2 Parallel strand lumber (PSL): headers as indicated.

- .3 Laminated strand lumber (LSL): studs as indicated.
- .4 Oriented strand lumber (OSL): studs as indicated.

2.3 FURRING AND BLOCKING

- .1 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S2S is acceptable
 - .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.
- .2 Where indicated, provide pressure treated materials for furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers in accordance with Section 06 05 73.

2.4 PANEL MATERIALS AND APPLICATION

- .1 Roof sheathing:
 - .1 Plywood, as shown on drawing S002.
- .2 Exterior wall sheathing:
 - .1 Plywood, as shown on drawing S002
- .3 Subflooring:
 - .1 Plywood, as shown on drawing S002
- .4 Electrical equipment mounting boards:
 - .1 Plywood, CSP, square edge 18.5mm thick.
 - .2 Fire retardant treated in accordance with Section 06 05 00- Wood Treatment.
- .5 Where indicated, provide pressure treated panel materials in accordance with Section 06 05 00.

2.5 MATERIALS AND PRODUCTS FOR TREATED WOOD FOUNDATIONS

- .1 Lumber and panel materials as shown on drawing S002 to: CAN/CSA-S406.
 - .1 Preservative treatment in accordance with Section 06 05 00- Wood Treatment.
- .2 Unless noted otherwise on drawing S002, fasteners and connectors, moisture barrier, sealant and field applied preservative: to CAN/CSA-S406 and in accordance with Section 06 05 00- Wood Treatment.

2.6 ACCESSORIES

- .1 Subflooring adhesive: to CAN/CGSB-71.26, cartridge loaded.
- .2 General purpose adhesive: to CSA O112.9.
- .3 Nails, spikes and staples: to ASTM F1667.

- .4 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .5 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.
- .6 Unless noted otherwise on drawing S001, joist hangers, connectors and fasteners: in accordance with accepted shop drawings, minimum 1 mm thick sheet steel, galvanized to minimum ZF001 coating designation.
- .7 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .8 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.
- .9 Fastener Finishes:
 - .1 Galvanizing: to ASTM A653 G60, use galvanized fasteners for exterior and basement location and where in contact with preservative treated lumber.
- .10 Sill Plate Gasket: Closed cell polyethylene foam gasket in width to match sill plate width, 6 mm thick.

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 SYSTEMS INTEGRATION

- .1 Install air barrier and vapour retarder sheeting around framing members to ensure continuity of protection and to lap and seal to main sheets.
- .2 Install insulation in exterior wall framing cavities that will not be accessible after completion of framing.
- .3 Install sill plate gasket in continuous lengths between concrete surfaces and wood framing.

3.3 FRAMING INSTALLATION

- .1 Install engineered framing and plant fabricated structural wood components, including all hangers, connectors and fasteners, in accordance with accepted shop drawings and manufacturers' instructions.
- .2 Install framing as noted on drawing S001.
- .3 Install members true to line, levels and elevations, square and plumb.
- .4 Construct continuous members from pieces of longest practical length.
- .5 Install spanning members with "crown-edge" up.
- .6 Select exposed framing for appearance. Install lumber materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .7 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .8 Countersink bolts where necessary to provide clearance for other work.
- .9 Install specified panel product for each application.
- .10 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 FURRING AND BLOCKING

- .1 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.
- .2 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.
- .3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .4 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using steel fasteners.
- .5 Install sleepers as indicated.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Div 1- 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 Div 1- Cleaning.

3.6 WASTE MANAGEMENT

- .1 Separate waste materials for recycling in accordance with Div 1ggggggg-Waste Management and Disposal.

- .2 Re-use scrap lumber to the greatest extent possible. Separate scrap lumber for use on site as accessory components, including shims, bracing, and blocking.
- .3 Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.
- .4 Do not burn scrap lumber that has been pressure treated.
- .5 Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

3.7 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 05 50 00 - Metal Fabrications
- .2 Section 06 10 00 - Rough Carpentry
- .3 Section 08 11 00 – Metal Doors and Frames
- .4 Section 08 44 00 - Aluminum Curtain Wall
- .5 Section 08 80 00 - Glazing
- .6 Section 09 90 00 - Painting and Coating
- .7 Div 10 - Specialties

1.2 Reference Standards

- .1 Do millwork to “custom” grade to Millwork Standards of the Architectural Woodwork Manufacturer's Association of Canada, latest edition.

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1.
- .2 Shop Drawings
 - .1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.
 - .2 Submit shop drawings to all interfacing sections requiring coordination.
- .3 Samples
 - .1 Submit duplicate 300 X 300mm samples of each type of solid wood or veneer plywood or plastic laminate to receive stain or transparent finish, in accordance with Division 1. Submit duplicate 600mm long samples of each type of trim and moulding.

1.4 Coordination & Verification

- .1 Verify all dimensions & existing conditions on job site prior to all shop fabrication and work on site. Where major discrepancies occur, alert Consultant immediately.
- .2 Coordinate work of this section with that of wall, ceiling-framing, electrical and mechanical sections where millwork and trim interface with drywall partitions, ceiling suspension, plumbing, electrical outlets, etc.
- .3 It shall be the responsibility of this section to verify the dimensions and installation details for all Departmental Representative supplied equipment and furnishings requiring cut-outs, adaptations and interfacing with millwork items.

1.5 Inspection

- .1 Architectural woodwork shall be manufactured and installed to AWMAC Quality Standards ("Custom" Grade) and shall be subject to an inspection at the plant and/or site, by an appointed inspector approved by the M.M.A.B.C. (the BC Chapter of AWMAC). Such inspection costs shall be included in the tender price for this project. Shop drawings shall be submitted for review before any work is commenced. Where it is deemed necessary by the Departmental Representative, a sample cabinet (consisting of a minimum of 1 drawer, 1 door, showing precisely the materials, hardware and the type of construction the manufacturer intends to use), shall be submitted for inspection.
- .2 Any work which does not meet AWMAC Quality Standards as specified, shall be replaced by this Trade Contractor at no additional cost to the Departmental Representative and to the satisfaction of the Departmental Representative and the inspector.

1.6 Guarantee

- .1 This Trade Contractor shall furnish the Departmental Representative with a two (2) year M.M.A.B.C. (The BC Chapter of AWMAC) Guarantee Certificate or an equivalent maintenance bond, to the full value of the architectural woodwork sub-contract, certifying that the architectural woodwork supplied will be in accordance with the Standards incorporated in the AWMAC Quality Standards manual, latest edition.
- .2 The Guarantee shall cover replacing and refinishing to make good any defects in architectural woodwork due to faulty workmanship or defective materials supplied by this Trade Contractor, which appear during a two (2) year period following the substantial completion of the Project.

1.7 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Div 1- Waste Management and Disposal, the Waste Reduction Workplan, and the Waste Management Plan to the maximum extent economically possible.

PART 2 PRODUCTS

2.1 Materials

- .1 Softwood lumber: to C.S.A. 0141-1970 and National Lumber Grades Authority requirements, with maximum moisture content of 6% for interior applications as follows:
- .2 Lumber selected for paint finish: Fir species to AWMAC Custom Grade.
- .3 Interior walls plywood finish: premium clear 19mm birch ply, sanded 1 side, for clear finish. For types and finishes, Refer to drawings and Appendix A (Materials & Colours Schedule)

- .4 Douglas Fir plywood: to C.S.A. 0121-M1978, good one side, sanded grade.
- .5 Shelving plywood: premium birch ply, sanded two sides, appearance grade for painting.
- .6 Nails and staples: to C.S.A. B111-1974, galvanized, typical.
- .7 Plastic Laminate: for flatwork, to CAN3-A172-M79, type general purpose, 1.5mm thick based on products as defined in the Finishes & Material Schedule. For types and finishes, Refer to drawings and Appendix A (Materials & Colours Schedule).
- .8 Quartz Composite Countertop. Non-porous, overall homogeneous material maintaining the same composition throughout the part with high content of quartz. Strong & durable product. For types and finishes, Refer to drawings and Appendix A (Materials & Colours Schedule)

2.2 Cabinet Hardware

Refer to Appendix A (Materials & Colours Schedule)

2.3 Locker Hardware

Refer to Appendix A (Materials & Colours Schedule)

2.4 Desk Hardware

Refer to Appendix A (Materials & Colours Schedule)

PART 3 EXECUTION

3.1 Cabinetwork

- .1 Cabinet doors shall be A.W.M.A.C. type overlay 19mm thick, flush.
- .2 Set nails and screws, apply stained plain wood filled to indentations, sand smooth and leave ready to receive finish.
- .3 Install and adjust cabinet hardware for shelves, doors, and drawers. Recess shelf standards unless noted otherwise. Shelving to be adjustable unless otherwise noted.
- .4 Provide cut-outs for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures. Make allowances for all wiring required within cabinet units, and conceal where possible. Refer to Mechanical and Electrical Drawings.
- .5 All shelving shall be plywood (no MDF shelving), birch veneer where painted.
- .6 Fit painted shelves with hardwood edging.
- .7 Details are shown on drawings for appearance purposes only and are not intended to supersede these specifications for fabrication methods or grades of material. Submit details with shop drawings.

- .8 Unless otherwise indicated, interiors of cabinets, all surfaces of concealed shelving and insides of drawers (except front panels) shall be melamine or shop-painted as scheduled.
- .9 Veneer backing shall be MDF where possible, birch ply elsewhere. Veneering to AWMAC standards for "custom" grade. No veneer backing for Plastic Laminate doors as per AWMAC standards.

3.2 Interior Trim

- .1 Standing and running trim for transparent and painted finish shall be A.W.M.A.C. Custom Grade construction. Trim shall be as detailed.

3.3 Installation

- .1 Set and secure cabinetwork and finish carpentry items in place rigid, plumb and square.
- .2 Use purpose designed fixture attachments for wall mounted components.
- .3 Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units, counter tops, and shelving.
- .4 When necessary to cut and fit on site, make material with ample allowance for cutting. Provide trim for scribing and site cutting.
- .5 Permanently fix cabinet and counter bases to floor using appropriate angles and anchorages.
- .6 Counter-sink all semi-concealed anchorage devices used to wall mount components and conceal with solid plugs of species to match surrounding wood. Place flush with surrounding surfaces.
- .7 Carefully scribe cabinetwork which is against other building materials, leaving gaps of 0.8mm maximum. Do not use additional overlay trim for this purpose.
- .8 Install and adjust all cabinet hardware to ensure smooth and correct operation.
- .9 Site-install all computer wire grommets into millwork as directed by Departmental Representative and indicated on drawings.
- .10 Use proper exterior and interior panel adhesives for shop-bonding aluminum sheets to backing. Use proper pressing techniques to eliminate potential "Telegraphing" and "oil canning".
- .11 Coordinate tile and stone work associated with millwork with Section 09 30 13 – Ceramic Tile.
- .12 Install all Departmental Representative-supplied equipment and components associated and interfaced with Finish Carpentry and Millwork.
- .13 Gently arise leading edge of MDF wall base. Mastic-apply.

3.4 Fire Retardant Treatment (Where Required)

- .1 Treat wood material by pressure impregnation with fire resistive chemicals in accordance with CAN/CSA-080-M or ASTM D-2898 to provide a flame spread rating of less than 25.
- .2 Fire retardant treated wood to bear underwriter's label or be accompanied by a certificate in a form acceptable to the Consultant showing compliance.
- .3 Conform strictly to the manufacturer's directions for delivery, handling and storage of treated wood.
- .4 Use galvanized steel fasteners for fastening fire retardant treated wood products.

3.5 Schedule of Finish Carpentry, Millwork Items

- .1 Supply and install the following carpentry and millwork items as shown and detailed or as specified, complete with all anchors and fastenings required for a complete installation:
 - .1 Coffee Counter, Cabinets & Lockers
 - .2 Security Room Workstation
 - .3 Service Counter & Gate
 - .4 Window @ Curtain Wall - Sill, jamb & head trim.
- .2 Installation of cabinet hardware, door hardware and finish components.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Wall cavity thermal insulation.
- .2 Rigid thermal insulation.
- .3 Concrete Faced Insulated Wall Panels (perimeter skirt).
- .4 Fiberglass thermal spacers.

1.2 Related Work

- .1 Section 07 21 29 - Sprayed Thermal Insulation
- .2 Section 07 27 13 – Self Adhered Membrane
- .3 Section 07 42 00 - Metal Wall Panel

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1.
- .2 Samples: Submit representative samples of each specified insulation material, insulation clips, adhesives, fasteners, tapes and other material for review.
- .3 Manufacturer's Product Data:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
 - .2 Submit data and installation instructions for materials and prefabricated devices, providing descriptions sufficient for identification at the site.
 - .3 Submit data from manufacturer's or independent laboratory indicating compatibility and adhesive results of proposed materials.

1.4 Reference Standards

- .1 Model National Energy Code for Buildings (NECB).
 - .1 Wall and grade slab assemblies to NECB 2015.

PART 2 PRODUCTS

2.1 Thermal Batt Insulation for Wood Studs and Framing

- .1 Friction-fit mineral wool fibre blankets, made from basalt rock and slag, thickness as noted on drawings, width-sized to fit wood studs and framing at 400mm o.c. (or as otherwise indicated) and possessing the following characteristics:

.1 CAN/ULC-S702-97	Thermal Insulation Mineral Fibre for Buildings	Type 1, Complies
.2 CAN4-S114	Determination of Non-Combustibility	Non-Combustible
.3 CAN/ULC S102	Surface Burning Characteristics	Flame Spread = 0 Smoke Developed = 0

- .4 CCM Evaluation Listing MasterFormat 07210: Mineral Fibre Batt Insulation 12018-L
- .5 Density (32 kg/m³) meets NBC/ULC Standards of CAN/ULC-S702-97
 4.8 kg/m² @ 150mm
 2.8 kg/m² @ 89mm
 2.0 kg/m² @ 65mm

.2 Thermal resistance rating: as indicated on drawings.

2.2 Rigid Thermal Insulation

.1 Extruded polystyrene insulation panels, purpose made for scheduled use including below floor panels and roof panel insulation, conforming to CAN/ULC-S701 Type 4, ship lapped edges, and meeting the values of the following table of properties:

Property and Test Method	Value
Thermal Resistance per 25 mm ASTM C518 @ 24°C mean Temp., m ² •°C/W min., R-value (RSI)	5.0 (.87)
Compressive Strength ⁽¹⁾ , ASTM D1621, kPa, min.	210
Water Absorption, ASTM D2842, % by volume, max.	<0.7
Water Vapour Permeance, ASTM E96, perm (ng/Pa•s•m ²)	0.9 (50)
Maximum Use Temperature °C	74
Coefficient of Linear Thermal Expansion, ASTM D696, mm/m•°C	6.3 x 10 ⁻²

2.3 Concrete Faced Insulated Wall Panels (perimeter skirt)

- .1 Latex modified concrete facing, bonded to 50mm rigid polystyrene foam insulation backing, with related flashings and accessory components, conforming to:
 - .1 CAN/ULC-S701, Standard for Thermal Insulations, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

Property and Test Method	Value
Thermal Resistance per 25 mm ASTM C518, R-value (RSI)	5.0 (.87)
Compressive Strength ⁽¹⁾ , ASTM D1621, kPa, min.	240
Water Absorption, ASTM D2842, % by volume, max.	<0.7
Water Vapour Permeance, ASTM E96, perm	0.8 (50)

2.4 Fibreglass Thermal Spacers

1. Thermal spacers for fastening roof sheathing to T.&G. decking shall be installed in the rigid insulation space.
2. Spacers shall be 100% pultruded glass fibre and thermoset polyester resin, height dimension to hatch thickness of rigid insulation.
3. Sizes, type and spacing of fasteners and attachment devices associated with the thermal spacer assembly shall be in strict accordance with reviewed shop/erection drawings as sealed by the Speciality Engineer, and of material which will minimize thermal bridging.

PART 3 EXECUTION

3.1 Batt Insulation Installation

- .1 Install insulation, in thicknesses as indicated, in such manner as to maintain continuity of thermal protection to building elements and spaces. Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .2 Do not compress insulation to fit into spaces.
- .3 Overlap thermal insulation sufficiently to maintain continuity.
- .4 Loose-fill all exterior hollow metal door frames with thermal batt insulation.

3.2 Rigid Insulation

- .1 Shop-install rigid insulation, as detailed in wall and floor assemblies.
- .2 Coordinate rigid roof insulation with spacing of fiberglass thermal spacers.

3.3 Concrete Faced Insulated Wall Panels

- .1 Install per architectural details and manufacturer's recommendations.
- .2 Dado corner joints to conceal insulation.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 All materials, labour, equipment and services required for the manufacture and installation of spray-applied polyurethane combination thermal insulation/air barrier system to building envelope elements where indicated, detailed and required.

1.2 Related Sections

- .1 Section 07 21 00 Building Insulation
- .2 Section 07 27 13 Self Adhered Membrane

1.3 References

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC) (latest editions)
 - .1 CAN-ULC-S705.1-98: Standard regarding rigid polyurethane foam spray thermal insulation, intermediate density – materials specifications.
 - .2 CAN-ULC-S705.2-98: Standard regarding rigid polyurethane foam spray thermal insulation, intermediate density – installer responsibilities.
- .3 Publications of the Canadian Urethane Foam Contractor Association (CUFCA).
- .4 National Building Code of Canada (NBCC), 2015.
- .5 Model National Energy Code for Buildings (NECB)
 - .1 Wall and grade slab assemblies to NECB 2015.

1.4 Submittals

- .1 Submit in compliance with Division 1, the results of all tests conducted in order to verify if the quality of the insulation material is equal or superior to the requirements outlined in this section.
- .2 Submit the results of all CCMC air barrier systems tests approved according to the CCMC's Technical Manual #07272 conducted in order to prove that the air barrier system meets National Building Code (2015) requirements.
- .3 Product Data Sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.

1.5 Mock-Ups

- .1 Create samples that are in compliance with Division 1.
- .2 Create a sample of 5 m² minimum, showing both inner and outer corners. This sample may be part of the completed structure.
- .3 Using the polyurethane foam insulation sample that was sprayed in place, the following trials must be conducted on site, as required by the Canadian Urethane Foam Contractor Association (CUFCA):
 - .1 Verify core density.
 - .2 Verify adhesion between any transition membranes and the substrate.
 - .3 Verify cohesion/adhesion between the insulation material and the substrate.
 - .4 Ensure results are in compliance and enter them in the CUFCA daily report.

1.6 Protective Measures

- .1 Ensure the work area is adequately ventilated, in compliance with requirements set out in Division 1 as well as WCB and WHMIS regulations.
- .2 Ensure continuous ventilation of the work area, through a fresh air intake and the extraction of foul air, during the course of the application process and for 24 hours thereafter.
- .3 Install temporary partitions in order to prevent any effect on the ambient air – outside of the work area – from the sprayed on insulation material.
- .4 Ensure all structures are well protected, in accordance with the manufacturer's recommendations.
- .5 Protect all adjacent surfaces and equipment against any damage that may be caused by dispersion and overspray of insulation material beyond prescribed limits.
- .6 All remaining foam particles must be flushed out of the spray gun on a daily basis. This procedure must be performed in areas designated for this purpose, and the contents of the empty containers neutralized accordingly to the procedure established by the CUFCA and other authorities having jurisdiction.

1.7 Delivery, Storage and Handling

- .1 Ensure that application equipment and packaged material can be accommodated by helicopter if site-applied.
- .2 All materials shall be delivered and stored in their original packaging bearing the manufacturer's name, quantity, CCMC numbers, and other appropriate technical indicators or references. The expiry date must also appear on the containers.

- .3 Store materials above ground, in a dry location, protected from weather, moisture and areas of high humidity. Damaged packages found unsuitable for use will be rejected and removed from the project.

1.8 Quality Assurance

- .1 The insulating material shall be applied by a company and personnel who are certified by the material manufacturer and CUFCA or the National Energy Conservation Association (NECA). These certified individuals must have their certification cards in their possession and available for presentation upon request.
- .2 Copies of the material manufacturer's and CUFCA installation manuals for the application of sprayed on polyurethane foam shall be kept on site.
- .3 Tests shall be conducted daily on both core density and cohesion/adhesion to the substrate, following procedures established by CUFCA/NECA. The results of these tests shall be entered in the daily report forms provided by CUFCA/NECA.
- .4 Adhesion tests shall be conducted on all corners, as well as the wall/slab intersections. Do one test on every wall that is less than 30 meters in length.
- .5 Verify the adhesion of any transition self-adhesive membranes at the perimeters of all openings.
- .6 Access to the jobsite by any material manufacturer's or CUFCA/NECA representative shall be permitted for the purposes of technical assistance or verifying operator certification or the quality of the polyurethane foam application.

1.9 Environmental Conditions

- .1 Only spray the insulating material if the surface and ambient air temperatures are within the manufacturer's prescribed limits. i.e., -10°C to +40°C.
- .2 Surfaces to be covered with polyurethane foam must be clean and dry, as required by CAN/ULC-S705.2. Since adhesion of the polyurethane foam is of the utmost importance, the substrate must be free of all frost, dust, oil, grease, oxidization, or any other element that may affect this property, nor should it present a high moisture content.
- .3 Metallic surfaces shall be checked to ensure no oxidization has occurred. Use of a primer is strongly recommended. Refer to the CUFCA manual.

1.10 Performance Requirements

- .1 Long Term Thermal Resistance LTTR: Tested by an independent laboratory in accordance with CAN/ULC S770-03 and achieving the following minimum values at a minimum core density of 28.34 kg/m³ (1.77 lb/ft³):
 - .1 RSI 0.91 per 25 mm @ 50 mm.
 - .2 RSI 0.95 per 25 mm @ 75 mm.
 - .3 RSI 0.98 per 25 mm @ 100 mm.

- .2 Aged R-values based on test methods other than LTTR or at densities lower than specified will not be accepted.
- .3 LTTR-values shall be based on density not less than minimum insitu density.
- .4 Core density shall be confirmed by field testing.

1.11 Coordination

- .1 Coordinate the work of this section with all interfacing sections, especially Section 07 27 13.
- .2 Coordinate with related work to allow for installation of required materials prior to spray insulation. Perform sprayed foam installation to ensure an un-interrupted and complete thermal and air barrier installation.

PART 2 PRODUCTS

2.1 Materials

- .1 Insulation: a spray polyurethane foam listed under CAN.ULC-S705.1, with CCMC #12840-R for insulation and CCMC #1232-R for the air barrier system, according to CCMC technical manual #07272, with the following physical properties:
 - .1 Density (ASTM D-1622) = 30.4 kg/m³, minimum Thermal resistance approved by the standard.
 - .2 Dimensional stability (ASTM D-2126), % volume change after 28 days: - 0.047% at -20°C, 8.45% at +100°C, 7.64% at +70°C with relative humidity >90±3%.
 - .3 Flame spread classification (CAN.ULC-S102, including S127) = 375.
 - .4 Compressive strength (ASTM D-1621), 10% parallel to rise = 222 kPa.
 - .5 Tensile strength (ASTM D-1623) = 337 kPa.
 - .6 Open cell content (ASTM D-2856) = <1%.
 - .7 Water absorption (ASTM D-2842) by volume = 2.5%.
 - .8 Water vapour permeance (ASTM E-96) = 125 ng/Pa.s.m².
 - .9 VOC during curing: Below detectable limit after 24 hours or during curing.
- .2 Primers: as recommended in the CIFCA/NECA Technical Manual, taking into account the type and condition of work surfaces.

2.2 Compatibility

- .1 Ensure that materials used are compatible with all interfacing materials. Obtain confirmation from sprayed foam insulation manufacturer.
- .2 Provide written proof of compatibility.

PART 3 EXECUTION

1.12 Installation

- .1 Shop-apply to pre0fabricated wall panels as detailed.

3.1 Manufacturer's Instructions

- .1 Follow the manufacturer's written instructions when spraying the polyurethane foam. Refer to manufacturer's technical product documentation, application guide section.
- .2 The manufacturer's recommendations shall be followed with regard to outside air temperature and substrate conditions (refer to manufacturer's data).
- .3 Spraying shall be done using a positive displacement pump with preset ratios specially designed for use with rigid polyurethane foam. Follow the directions for use and the cleaning and maintenance procedures set out in the equipment manufacturer's manual.

3.2 Examination

- .1 Verify existing conditions before commencing work.
- .2 Verify that substrate is free of any foreign material that will impede application.
- .3 Verify that other work on and within spaces to be insulated is complete prior to application.
- .4 Notify Departmental Representative of conditions that would adversely affect the application.
- .5 Commencement of installation implies applicator accepts existing conditions.

3.3 Preparation

- .1 Comply with manufacturer's written installation instructions for preparing substrates indicated to receive sprayed insulation.
- .2 Mask and protect adjacent surfaces from overspray or damage.
- .3 Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.

3.4 Application

- .1 Shop-apply insulation to building envelope elements where indicated on drawings and reasonably required.
- .2 Spray the foam in consecutive layers of no less than 12.5 mm and no more than 50 mm thick each, for a total thickness as indicated on drawings.
- .3 Cover all excessively wide joints prior to application of polyurethane foam insulation.

- .4 Spray apply polyurethane foam with a tolerance of +6/-0 mm in relation to the specified thickness.
- .5 When spraying polyurethane foam, avoid the formation of sub-layer air pockets.
- .6 Avoid spraying the foam on any surfaces other than those indicated. Use dropsheets or masking tape to protect other surfaces.
- .7 Once the foam has hardened, remove all overspray from non-prescribed surfaces while at the same time taking care not to damage them.
- .8 Do not allow polyurethane foam, once applied, to be damaged during work by other trades, unless prior agreement has been reached.
- .9 Ensure the subsequent coverage of the applied insulating foam will be completed within the manufacturer's prescribed time frame. Refer to manufacturer's technical product documentation.
- .10 Spray apply the polyurethane foam in overlapping layers, so as to obtain a smooth, uniform surfaces.
- .11 In cold weather when applying on a flat surface of more than 15 lineal meters in either direction, apply the first layer in 3 meter strips at 1 meter intervals. After the curing period (± 4 hours) has elapsed, spray the polyurethane foam on the unfilled spaces.
- .12 Do not spray polyurethane foam any closer than 75 mm from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray the insides of any exit openings or electrical junction boxes (refer to the CUFCA/NECA manual).
- .13 Cover all mechanical fixtures and electrical boxes with polyurethane foam in order to reduce thermal bridging.
- .14 Completely fill voids between metal stud flanges and exterior concrete walls with sprayed thermal insulation.
- .15 Leave sprayed thermal insulation ready for covering with drywall at walls and sprayed fire resistive crust at soffits.

3.5 Field Quality Control

- .1 Inspect application for insulation thickness and density. Rectify deficiencies.

3.6 Protection and Cleaning

- .1 Do not permit subsequent work to disturb applied insulation.
- .2 As work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from this work.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Proprietary plastic moisture barrier system below concrete slab on grade.

1.2 Related Work

- .2 Section 07 21 00 Building Insulation
- .3 Section 07 27 13 Self Adhered Membrane

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1;
- .2 Product Data Sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit sample of proposed products for review by Departmental Representative.

PART 2 PRODUCTS

2.1 Moisture Barrier-Membrane-Slabs, Walls & Roof

- .1 Membrane Material:
 - .1 Permeance, as tested after conditioning: 0.6 ng (Pa*s *m²)(0.01 perms (gm/ft²/in-Hg)) to ASTM E1745-09 paragraphs 7.1.2 through 7.1.5.
 - .2 Strength: Class A to ASTM E1745-09.
 - .3 Thickness of plastic:
 - 1. For Slabs, 0.38 mm (15 mils) minimum.
 - 2. For Walls and Roof, 0.152 mm (6 mils) minimum,
 - .4 Moisture barrier membrane joint tape:
 - .1 Description: High density polyethylene tape, pressure sensitive, 100 mm wide, product as per vapour barrier membrane manufacturer's installation instructions.
 - .5 Penetration flashing:
 - .1 Vapour barrier membrane material and vapour barrier joint tape in accordance with manufacturer's instructions.
 - .6 Acceptable Products:
 - .1 W.R. Meadows 'PERMINATOR', thickness specified above.
 - .2 Stego Industries 'Stego-Wrap', thickness specified above.
 - .3 Or approved equal.

PART 3 EXECUTION

3.1 Under-Slab Moisture Barrier Installation

- .1 Place under all new interior concrete slabs on grade (over rigid insulation) where present.
- .2 Level gravel base, place rigid insulation and take care to avoid damaging membrane when laying reinforcing and concrete.
- .3 Place screeds to require a minimum number of perforations.
- .4 Install moisture barrier membrane in accordance with manufacturer's instructions and ASTM E1643-09.
- .5 Install moisture barrier membrane using largest practical sheet size to minimize joints over compacted fill.
- .6 Inspect vapour barrier membrane sheets for continuity. Repair punctures and tears in vapour barrier membrane with sealing tape before work is concealed.
- .7 Moisture barrier membrane installation shall be continuous and vapour tight.
- .8 Overlap moisture barrier membrane joints 200 mm minimum and tape seal with vapour barrier joint tape.
- .9 Unroll membrane with longest dimension parallel with direction of concrete placement.
- .10 Lap membrane up foundation walls and column footings a minimum of 100 mm and tape seal with vapour barrier joint tape.
- .11 Centre joint tape over membrane laps and joints. Keep area of tape adhesion free of dust, dirt, and moisture.
- .12 Cut slit around pipes, ductwork, rebar, and wire penetrations to place the initial layer of moisture barrier membrane. Protect the concrete slab from external moisture sources vapour barrier membrane and place a collar around this as well.
 - .1 Cut a piece of membrane minimum width of 300 mm. The length should be 1-1/2 times the pipe circumference. With a roofer's knife or scissors, cut "fingers" half the width of the film.
 - .2 Wrap membrane around and tape the collar onto the pipe and completely tape fingers to the bottom layer of vapour barrier membrane with vapour barrier joint tape.
- .13 In the event that moisture membrane is damaged during or after installation, repairs shall be made. Cut a piece of membrane large enough to cover damage by minimum overlap of 150 mm. Clean adhesion areas of dust, dirt, and moisture. Tape down edges using vapour barrier joint tape.

3.2 Wall Vapour Barrier Installation

- .1 Install polyethylene on warm side of insulation as indicated and tight to insulation.
- .2 Fix vapour barrier to framing members. Lap joints min. 6". Ensure joints occur over framing members.
- .3 Tape seal at points of penetration. Attach warning labels to walls with vapour barrier.
- .4 Extend vapour barrier tight to perimeter

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Sheet-applied self-adhesive combination air/vapour barrier sheathing and flashing/transition membrane at rain screen cavity assemblies.
- .2 Sheet-applied self-adhesive foil-faced membrane flashing required to provide continuity detailing at interruptions in wall envelope such as fenestration.
- .3 Liquid-applied flashing membrane as a wall penetration and detailing sealant.

1.2 Related Work

- | | | |
|----|------------------|--------------------------------------|
| .1 | Section 07 52 00 | Modified Bituminous Membrane Roofing |
| .2 | Section 07 62 00 | Sheetmetal Flashing and Trim |
| .3 | Section 08 44 00 | Aluminum Curtainwall |

1.3 Quality Assurance

- .1 Qualifications: Work of this section shall be executed by competent installers with minimum 5 years experience in application of products, systems and assemblies specified and with approval and training of product manufacturer.
- .2 Conduct quality control in accordance with Division - 1.
- .3 All sealants, primers, mastics and adhesives associated with the sheathing membrane shall be products of said sheathing membrane manufacturer.

1.4 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Product data sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
- .3 Mock-up:
 - .1 Construct minimum 10 m² area of wall assembly if requested.
 - .2 Locate at the place of work as part of final installation. Space installation to include exterior wall panel incorporating window, glazing system and installation.
 - .3 Do not proceed until mock-up has been reviewed by the Consultant.
- .4 Samples:
 - .1 At the Consultant's request, samples of materials shall be submitted for approval, prior to commencing work concerned.

1.5 Product Delivery, Storage and Handling

- .1 Deliver and store all materials in their original packaging in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, CSA and other references to accepted standards clearly shown.
- .2 Make all necessary arrangements with regard to delivery and storage on the site with the Departmental Representative and schedule deliveries accordingly. In

general, deliver material as required for installation and keep site storage to a minimum.

- .3 Provide all plant and equipment necessary for off-loading of materials to complete the work of this section.
- .4 Protect materials from damage, weather and store in a dry place.
- .5 Handle materials and equipment in strict accordance with manufacturer's recommendations. Damaged or deteriorated materials shall be removed from premises.

1.6 Job Conditions

- .1 Conform to membrane manufacturer's requirements for minimum application temperatures and humidity. Check surfaces and areas specified and shown to receive membrane.
- .2 Report any unsatisfactory conditions and/or surfaces to the Departmental Representative in writing. Starting work shall imply acceptance of surfaces and conditions.
- .3 Take all necessary measurements and levels at the building. The work shall be laid out to accurately fit the conditions at the building and with adjacent work.
- .4 Notify the Departmental Representative of any variations beyond the accepted tolerances in the substrate or in the adjacent work, including membrane roofing (Section 07 52 00).
- .5 Provide forced air circulation during curing period for enclosed applications.
- .6 Low temperature application:
 - .1 Perform adhesion test for membrane when ambient temperature is below -5°C. Sheathing membrane manufacturer must produce both "summer" and "winter" (low temp.) grades.
 - .2 Proceed with work when temperature is (or predicted) to fall below -5°C ambient temperature only with the mutual documented agreement of inspection and testing company, manufacturer and applicator.
- .7 Do not perform installation during rainy or inclement weather or on wet or frost covered surfaces.
- .8 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

1.7 Performance Requirements

- .1 Sheathing membrane system shall perform as a continuous air barrier and liquid water drainage plane flashed to discharge incidental condensation or water penetration to the exterior of the building envelope.
- .2 The membrane flashing/universal transition membrane shall perform as flashing by providing continuity at interruptions in sheathing systems caused by openings in building structure and interfacing with other elements and systems. The membrane system is also employed as a transition membrane between envelope components and other membranes and waterproofing systems. Ensure compatibility between systems.

- .3 All self-adhesive membrane systems shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding the specified limits and requirements, or interruption of the drainage plane.
- .4 Air barrier systems shall be joined in an airtight and flexible manner to air barrier material of adjacent building envelope systems, employing transition membrane, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Foundation and walls.
 - .2 Walls and openings (windows, doors, louvers, and other wall penetrations).
 - .3 Different wall systems.
 - .4 Wall and roof.
 - .5 Wall and roof over non-climate controlled space.
 - .6 Walls, floor and roof across construction, control, and expansion joints.
 - .7 Walls, floors and roof to utility, pipe and duct penetrations.
- .5 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

PART 2 PRODUCTS

2.1 Vapour-Permeable Sheathing Membrane

- .1 Description: self-adhesive membrane composed of a tri-layer laminated polypropylene facer.

The sheathing membrane shall comply with the following criteria and values:

 - .1 Air permeance: Maximum 0.0025 L/s m² at 75 Pa to ASTM E2178-03
 - .2 Must pass ASTM 2357 air leakage resistance criteria.
 - .3 Water vapour transmission: 972 ng/pa•s•m² (17 perm) to ASTM E96 (Procedure 'B').
- .2 Acceptable Products: Soprema SopraSeal Stick VP, or similar

2.2 Self-Adhesive Flashing/Transition Membrane

- .1 Description: Self-adhering modified bituminous membrane system consisting of SBS modified bitumen and a tri-laminated woven polyethylene facer. The underface shall be covered with a silicone release paper or film. Membrane shall be available in "summer" and "winter" grades and shall comply with the following physical properties:
 - .1 Thickness: 1.0 mm (40 mils) minimum.

- .2 Application temperature: as per manufacturer's printed installation instructions.
- .3 Min. tensile strength to ASTM D5147: 11.3/15.4 kN/m (64/88 lb/in).
- .4 Min. tensile strength to ASTM D412: 11.2/31.1 MPa.
- .5 Static puncture: 400 N (90 lb) to ASTM D5602; 747 N (168 lb) to ASTM E154.
- .2 Primer: as manufactured by membrane manufacturer specifically for membrane.
- .3 Termination mastic: as recommended by membrane manufacturer.
- .4 Ensure that self-adhering membrane is compatible with and will adhere permanently to all interfacing substrate materials and systems, including foil-faced membrane (2.2) and Membrane Roofing (Section 07 52 00).
- .5 If required by the Consultant, demonstrate accelerated long term adhesion to all substrate appropriate to this Project. Refer to Section 01 45 00.
- .6 Acceptable Products:
 - .1 Protecto Wrap "100/40"
 - .2 Grace Construction Products 'Perm-A-Barrier Wall Membrane'.
 - .3 Soprema 'Sopraseal Stick 1100T Summer Grade and Winter Grade with 'Elastocol Stick' primer.
 - .4 "HT"-designated high-temperature membrane for high-temperature applications (e.g. parapet cap flashings): Lastobond Shield HT by Soprema, or Blueskin PE 200 HT by Monsey-Bakor.

2.2 Self-Adhesive Foil-Faced Membrane Flashing

- .1 Multi-purpose, self-adhering detailing membrane for use at door/window openings, vents and other interruptions in the wall membrane system.
- .2 Membrane shall be composed of a proprietary base fabric/film laminated to an aluminum foil and available in various roll widths.
- .3 Acceptable products:
 - .1 'Protector Seal 45" by Protecto Wrap.
 - .2 "Sopra Solin HD" by Soprema.
 - .3 Other products with similar characteristics and proven long term adhesion to moist substrates will not be excluded.

2.3 Liquid-Applied Flashing Membrane

- .1 Liquid-applied flashing membrane for use as a sealant at penetrations to the wall sheathing membrane, as a detailing sealant and as noted and detailed.
- .2 Material shall be a gun grade waterproofing, adhesive and detailing compound composed of 99% solids, roller/trowel/brush applied, single component, high performance, elastomeric, silyl-terminated polyester coating/sealant exhibiting the combined benefits of silicone and urethane. Product shall meet all current VOC requirements and contain no solvents or isocyanates.
- .3 Liquid-applied flashing system shall comply with the following properties when cured:

- | | | |
|----|---------------------------|--|
| .1 | Hardness, Shore A | 40—45 |
| .2 | Tensile Strength | 180 Psi |
| .3 | Elongation at Break | 400% |
| .4 | Peel Strength | 25 pli |
| .5 | Accelerated Weathering | Must Pass |
| .6 | Water Vapour Transmission | 14 perms @ 12 mils |
| .7 | Surface Burning ASTM E84 | Flame Spread: 0
Smoke Developed: 15
NFPA and ICC Class A Building Material |
- .4 Uncured properties:
- | | | |
|----|---------------------------|-----------------------------------|
| .1 | Tack Free Time | <30 minutes |
| .2 | Cure Rate | 3/16 inch/24 hours |
| .3 | Volatile Organic Content | 1.5% by wt.
27 g/Lt .2 lbs/gal |
| .4 | Water Vapour Transmission | 6.34 grains/hour/Ft ² |
- .5 An example of the accepted product is “R-Guard Fast Flash” as manufactured by Proso. Other products having the same demonstratable characteristics will not be excluded.

2.4 Waterproofing Self adhered membrane - Foundation

- .1 Description:
- self-adhesive waterproofing membrane composed of SBS modified bitumen and a tri-laminated woven polyethylene facer with underface covered with silicone release film.
 - Application temperatures: Winter grade: -10 to 10°C (14 to 50°F)
 - Summer grade: 10 to 50°C (50 to 122°F)
 - Minimum thickness of 1.5 mm (60 mil)
- .2 Acceptable Products: Soprema COLPHENE 3000, or similar

2.5 Accessories

- .1 Termination Bar: Minimum 18 Ga. steel, or 1/16” aluminium. Material G200 galvanized steel or aluminium. Size 1.5” (38 mm) wide x continuous lengths where possible. Install gum lip, where applicable.

PART 3 EXECUTION

3.1 Preparation

- .1 Preparation of all surfaces to receive self-adhering membranes including substrate, joints, cracks, coves etc. shall be carried out in accordance with manufacturer's written directions.
- .2 Ensure that all substrate surfaces are smooth, dry and firm. Remove any frost,

ice, loose particles, ridges, laitance, cracks, grease, asphalt, oil and other foreign matter which could prevent adhesion of the membrane to the substrate.

- .3 Do not install membranes until other work which penetrates membrane has been completed.
- .4 Seal around membrane penetrating elements in accordance with manufacturer's printed installation instructions.

3.2 Priming

- .1 All surfaces to receive self-adhering membrane shall be primed at the rate recommended by the manufacturer. Primer shall be uniformly applied.
- .2 Open time of 30 minutes shall be allowed before installation of self-adhering membrane.

3.3 Sheathing Membrane Installation

- .1 Install membrane in accordance with manufacturer's printed instructions over flashings and corner reinforcement.
- .2 Begin installation at the base of the wall placing top edge of membrane immediately below materials protruding from substrate.
- .3 When properly positioned, place against surface by pressing firmly into place. Roll membrane with extension-handled countertop roller immediately after placement.
- .4 Overlap horizontally-adjacent pieces 50 mm and roll seams.
- .5 Vertical laps shall be 150mm overlap. 300mm overlaps at corners.
- .6 Bottom edge shall be slit to fit around penetrations. Membrane shall overlap the membrane sheet below by 50 mm. Roll firmly into place.
- .7 Seal around materials penetrating membrane with termination mastic. At end of each working day, seal top edge of membrane to substrate with termination mastic.
- .8 Do not allow the rubberized asphalt surface of membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
- .9 Do not expose membrane to sunlight for more than thirty days prior to enclosure.
- .10 Apply a bead or towel coat of mastic along membrane edges, seams, cuts, and penetrations.
- .11 Roll membrane with 75 mm wide hand roller.
- .12 Tie into adjacent wall systems and roof systems for continuous air barrier at building envelope.
- .13 Flashing and Corner Reinforcing:
 - .1 Where applicable, bring flashing a minimum of 150 mm onto horizontal surfaces and a minimum of 200 mm up walls from horizontal elevation shown.
 - .2 Stagger flashing and membrane seams.
 - .3 Install flashing to protrusions, expansion joints, control joints and the like. Bring flashing a minimum of 150 mm onto the membrane.

- .4 Wrap air barrier membrane into jambs and sills at openings. Terminate membrane at points that will prevent visibility from interior.
- .14 Inspection: Inspect membrane for punctures, misaligned seams and fishmouths, apply additional layer of membrane over affected area, extending minimum of 150 mm beyond damaged area in all directions.
- .15 Coordinate proper construction of the roof/wall intersection to maintain the continuity of the air barrier system from the wall to the roofing membrane system.

3.4 Transition/Flashing and Foil-Faced Membrane Installation

- .1 Apply self-adhering "detailing" membranes to surfaces as indicated on drawings and as specified.
- .2 Application of membrane, including temperature limitations, curing requirements and all other application procedures shall be carried out in accordance with membrane manufacturer's written directions.
- .3 Coordinate proper construction of roof/wall junctions between Section 07 27 13 and interfacing materials and systems so as to maintain continuity of the air barrier from wall to roof.
- .4 Cut and seal membrane around protrusions to form tight air seal.
- .5 Apply trowelled bead of mastic to all terminations at end of each day's work.
- .6 Inspect membrane thoroughly before being covered and make any corrections immediately. Misaligned or inadequately capped seams, punctures or other damage shall be repaired by patching and sealing with membrane manufacturer's directions.
- .7 Adhere transition membrane to sheathing membrane at wall openings and flash into pckets of fenestration, louvers and doors as detailed, taking extra care to ensure continuity of the air/vapour barrier.
- .8 Membrane shall be continuously supported.
- .9 Extend all membrane patches a minimum 150 mm from repair location or penetration. Seal all around patch with mastic.
- .10 Seal all side laps without factory bitumen edge and all top laps with mastic.
- .11 Fill all joints or gaps wider than 6 mm with foam backer rod and apply 300 mm piece of membrane over joints prior to application of the field membrane.
- .12 Coordinate installation of membrane with other interfacing Sections to minimize exposure of membrane.
- .13 When self-adhering membrane interfaces with incompatible membranes, ensure that bond is made only to bridge membranes.

3.5 Liquid-Applied Flashing Membrane Application

- .1 At penetrations to all self-adhered wall sheathing and transition membranes: Apply liquid-applied flashing system onto foil-faced self-adhered membrane in strict accordance with manufacturer's printed instructions by brush, roller or towel between ambient temperatures of +1°C and 30°C.

3.6 Waterproofing Self Adhered Membrane Installation

Refer to manufacturer installation guide.

3.7 Adjust and Clean

- .1 Repair, remove and clean all smears on exposed finished surfaces or surfaces to be subsequently finished. Clean off immediately as directed by and to the satisfaction of the Consultant. Protect all adjacent surfaces from damage due to self-adhered membrane operations. As work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from this work.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Furnish all materials, labour, equipment and services, necessary for the detailed design, erection drawings, shop drawings, fabrication and erection of the V-Groove planks extruded aluminum wall panel system component of a pressure equalized rainscreen assembly, and cap flashings at parapets & Soffits.
- .2 Include all concealed fastening, sealants, required sub-framing and matching flashing and accessories.

1.2 Related Sections

- | | | |
|----|------------------|------------------------------|
| .2 | Section 07 27 13 | Self-Adhered Membrane |
| .3 | Section 07 21 00 | Insulation |
| .5 | Section 07 62 00 | Sheetmetal Flashing and Trim |
| .6 | Section 07 92 00 | Joint Sealants |
| .7 | Section 08 44 00 | Aluminum Curtainwall |

1.3 References

- .1 Roofing Practices Manual as published by the Roofing Contractor's Association of British Columbia (RCABC).
- .2 Sheet Metal and Air Conditioning Contractor's National Association, Inc., "Architectural Sheet Metal Manual" (SMACNA).
- .3 ASTM B32 – Standard Specification for Solder Metal.
- .4 ASTM D968 – Standard Test Methods for Abrasion Resistance of Organic coatings by Falling Abrasive.
- .5 ASTM E96 – Standard Test methods for Water Vapor Transmission of Materials.
- .6 Canadian Sheet Steel Building Institute (CSSBI) Technical Bulletins No. 5, 6, 7 and CSSBI Standards for Sheet Metal Cladding.
- .7 NBCC (2015).

1.4 Submittals & Specialty Engineering

- .1 Submit product data, shop/erection drawings and samples in accordance with Division 1
- .2 Shop Drawings:
 - .1 Submit shop details and erection drawings in accordance with Division 1. Shop drawings shall be sealed by a professional Engineer registered in British Columbia, referred herein as "Specialty Engineer".
 - .2 Indicate materials, core thicknesses, profiles, dimensions, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcements, details, and accessories.

- .3 Letters of Assurance: the Engineer who seals the shop drawings submission shall submit an APEGBC Model Schedule S-B: Assurance of Professional Design and Commitment for Field Review, and Model Schedule S-C: Assurance of Professional Field Review and Compliance by supporting registered professional (SRP).
- .4 Where metal wall cladding and associated components interface with equipment and other building elements, this section shall be responsible of obtaining all measurements of said items prior to preparation of shop drawings.
- .3 Samples:
 - .1 Submit to Departmental Representative for approval prior to fabrication: Representative sample of sufficient scope and size to demonstrate panel profile, corner treatment and joint lap.
 - .2 Provide sample of zinc alloy panel material finish including any portion of panel which has been formed after application of finish for approval by Departmental Representative.
- .4 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications, data sheets, qualifications, product test reports, maintenance instructions and sample of standard warranty.

1.5 Delivery, Storage, and Handling

- .1 All materials delivered to the site shall be stored in spaces designed by the Consultant. Materials shall not be exposed to moisture or damage.
- .2 Components and assemblies shall be transported, handled and stored in a manner to prevent damage of any nature. Materials shall be protected as prescribed by cladding manufacturer.
- .3 Delivered materials which are damaged in any way or do not comply with these specifications will be rejected by the Departmental Representative and shall be removed from the job site and replaced with acceptable materials at this Section's expense.

1.6 Quality Assurance

- .1 Installation of pre-formed metal cladding shall be performed by manufacturer-approved installers having at least five years experience in metal cladding installations.

1.7 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Div 1 - Waste Management and disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal: paper, plastic, polystyrene, corrugated cardboard, packing material in appropriate on-site containers for recycling in accordance with Waste Management Plan.

1.8 Design Criteria

- .1 Design wall cladding in accordance with the latest edition of:
 - .1 CAN/CSA-S136 for the Design of Cold Formed Steel Structural Members.
 - .2 Specified loads, load factors and load distributions shall be in accordance with the NBCC 2018 unless otherwise stated.
- .2 Design metal wall cladding system employing “limit states design” method.
- .3 Deflection of cladding is not to exceed 1/90 of the span for live loading as specified in the NBCC 2015.
- .4 Design pre-formed wall cladding system to provide for thermal movement of component materials caused by ambient temperature range of 70°C without causing buckling, failure of seals, leakage and undue stress on fasteners or other detrimental effects.
- .5 Ensure water tightness of wall system is continuous, is sealed at openings and terminations and is overlapped at changes in wall structure.

1.9 Compatibility

- .1 Compatibility between components of cladding system and between cladding system and interfacing components is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.

1.10 Warranty

- .1 Warranty Period:
 - .1 Material: 5 years from date of Substantial Completion. (Provided by the Panel Material Manufacturer.
 - .2 Installation: 2 years from date of Substantial Completion. (Provided by the Fabricator/Installer).
 - .3 Failures include, but are not limited to, the following:
 - .1 Structural failures, including rupturing, cracking, or puncturing.
 - .2 Deterioration of metals and other materials beyond normal weathering.
 - .3 Oil-canning or buckling due to thermal movement or building structural deflections.

1.11 Maintenance

- .1 Submit the manufacturer's documentation covering the care, cleaning and maintenance of materials for incorporation into maintenance manuals. Refer to Division – 1 Closeout Submittals.

1.12 Coordination

- .1 Coordinate spacing of subgirts to minimize cutting of cavity wall insulation and other interfacing elements.
- .2 Coordinate work of this Section with that of all interfacing Sections.

PART 2 PRODUCTS

2.1 Cladding and Soffit Materials

- .1 Refer to Appendix A (Materials & Colours Schedule)

2.2 Associated Flashing and Trim

- .1 Provide all components required for a complete formed metal wall and soffit panel assembly including trim, copings, fascia, sills, corner units, flashings, and similar items.
- .2 All flashing and miscellaneous trim associated with wall panel system shall be fabricated by wall panel supplier from same materials, finish and quality as adjacent wall panels.
- .3 Closures shall be fitted tightly, and all detailing shall be executed neatly in a workmanlike manner to render a complete weatherproof assembly. Refer also to Section 07 62 00.

2.3 Girts and Framing

- .1 Sizes, gauges and spacing of all sub-framing and wall attachment components shall be in strict accordance with approved shop/erection drawings as sealed by the Specialty Engineer.
- .2 Girts shall be non-corrosive metal (G200 galvanized, or AZM 150 Galvalume coating) either hat-shaped, 'C' or 'Z' sections of sufficient width to allow for free air movement in the rain screen cavity.
- .3 All horizontal framing shall be perforated at regular intervals to permit free drainage of cavity.

2.4 Fasteners

- .1 Sizes, material, type and spacing of all fasteners and attachment devices associated with the formed metal wall panel assembly shall be in strict accordance with approved shop/erection drawings as sealed by the Specialty Engineer.

- .2 Fasteners shall be concealed and non-corrosive/non-galvanic with contact materials: stainless steel or 200-hour salt-spray tested.

2.5 Metal Protection

- .1 Where dissimilar metals contact each other or where metals contact other corrosive substrates, protect against galvanic action or metal deterioration with isolation tapes and agents as recommended by metal manufacturer.

PART 3 EXECUTION

3.1 Examination

- .1 Examine substrate surfaces to receive formed metal wall and soffit panel system and associated work and the condition in which work will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer, fabricator, Specialty Engineer and consultant.
- .2 Report any discovered discrepancies to the Consultant so that instructions may be given for the necessary remedial work.

3.2 Preparation

- .1 Prepare substrate surfaces to insure proper and adequate installation in accordance with the contract documents, approved shop drawings, and manufacturer's written requirements and instructions.
- .2 Field measurement and verification of dimensions are required.
- .3 Protect adjacent areas or surfaces from damages as a result of the work in this section.
- .4 Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C754, Specialty Engineer's written instructions and approved/sealed shop and erection drawings.

3.3 Erection General

- .1 Install formed metal wall and soffit panel systems in strict accordance with panel fabricator's written instructions and approved/sealed shop and erection drawings to produce a complete weatherproof pressure equalized rainscreen assembly.
- .2 Erect panels plumb, true and level and in correct alignment with established lines and elevation shown on approved shop and erection drawings.
- .3 Install all girts, clips, anchors, and flashing securely to surrounding construction spaces to afford maximum rigidity.
- .4 Provide all openings for mechanical and electrical services, piping, louvers, etc., penetrating panels. Provide weathertight flanges, flashings, reinforcing and

sealant around all penetrations exposed to the weather and or as shown on the drawings.

- .5 Joints shall not be less than their dimensioned width or more than five percent (5%) greater than their dimensioned width at any location along their full length and shall not be wavy, out of line, or of different width panel to panel.
- .6 Installed panels shall not deviate from overall plane or alignment more than 1/16" in 3'-0". Adjacent panels shall not deviate from plane and alignment by more than 1/32" along their length.

3.4 Accessory, Trim and Flashing Installation

- .1 Install trim, flashing and accessories with positive anchorage to building utilizing weather tight mounting and provision for thermal expansion. Coordinate installation with wall panels and other interfacing components.
- .2 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual". Provide concealed fasteners and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.5 Field Quality Control

- .1 The fabricator's professional specialty engineer shall be responsible for periodic inspections during construction as required. Such inspections and associated costs shall be included in the Contract Price.
- .2 At completion of the work, said specialty engineer shall submit to the consultant copies of field review reports for each site visit made and a final signed and sealed letter of assurance of "professional field review" and "compliance" indicating that the copper plate wall panel system has been installed in accordance with the manufacturer's requirements, the standards specified herein and the approved shop drawings.

3.6 Clean-Up

- .1 Remove manufacturer's protective film at appropriate time in advance of the date of substantial performance of the Project. Review concurrently to ensure there is no damage or marring to the wall panels. Replace damaged or marred panels accordingly to the approval of the Consultant.
- .2 Clean panels to remove surface dust, dirt, stains and marks on the panels caused by ambient environmental weather conditions and construction activities. Use cleaners approved by the manufacturers' of surfaces to be cleaned. Protect panels from damage by other trades.
- .3 At completion of the work of this Section, remove any excess materials, debris and equipment, pertaining to the work of this Section, from the site.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 All materials, equipment and installation for two-ply elastomeric modified bituminous membrane systems (SBS) to new sloped structure steel decked roofs including combination sheathing board/air/vapour barrier, base and cap plies, associated membrane flashing (stripping plies), and traffic walkways.
- .2 Rigid polyisocyanurate thermal roof insulation, (factory-tapered for crickets, back-slopes and where indicated) and mineral fibre insulation/protection layer.

1.2 Related Sections

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 07 62 00 Sheetmetal Flashing & Trim
- .3 Section 07 92 00 Joint Sealants
- .4 Division 22 Plumbing
- .5 Division 23 Heating, Ventilation & Air Conditioning

1.3 References

- .1 The latest version of the following tests and publications:
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM D6162-00a, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 37-GP-56M-80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced Roofing.
 - .2 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
 - .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement.
 - .4 CGSB 37-GP-56M-80, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
 - .5 CAN/ULC-S704-03, Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.
- .4 Canadian Roofing Contractors Association (CRCA).
 - .1 CRCA Roofing Specifications Manual – Latest Edition
- .5 Roofing Contractors Association of British Columbia (RCABC)
 - .1 Roofing Practices Manual – Latest Edition
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA)
- .7 Factory Mutual (FM Global).

- .1 FM Approvals – Roofing Products.
- .8 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 National Building Code of Canada, 2015 (NBCC) and BC Building Code, 2018 (BCBC).
- .10 ASHRAE 90.1, 2010

1.4 Performance Requirements

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.
- .2 The roof assemblies shall have a minimum Class A designation in accordance with NBCC, 2010 (3.1.15.2.1) and ULC S107.

1.5 Submittals

- .1 All submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit two copies of most recent technical roofing components data sheets describing materials' physical properties.
- .3 Submit WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 35 33 – Health and Safety Requirements.
 - .1 Indicate VOC content for:
 - .1 Primers
 - .2 Asphalt
 - .3 Sealers
 - .4 Tapered Insulation
- .4 Provide layout for factory-tapered insulation.
- .5 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .6 Provide to the Departmental Representative the "RCABC Roofing System Record" upon completion of the work. Record shall include copies of inspection reports and roof maintenance guide.
- .7 Submit copies of underwriter's certification for roof covering materials.

1.6 Quality Assurance

- .1 Unless otherwise specified, all materials and roofing practice shall conform to the recommendation of the RCABC as contained in their manual, Roofing Practices in British Columbia. Where this manual is silent, the recommendation of the CRCA as contained in their manual Roofing Specifications, shall be followed.
- .2 This Contractor shall at all times, have in his Field Office, a copy of said manuals.
- .3 All work shall be done by a member of the Roofing Contractor's Association of British Columbia and in accordance with the manufacturer's instructions and latest standards of RCABC

- .4 All work of this section shall be installed only by workers, foremen, superintendents and management, whose workmanship is approved by the membrane manufacturer and supplier. Proof of such approval and of the experience of such personnel shall be submitted to the Departmental Representative prior to the start of the work.
- .5 Obtain all roofing materials from the same source to ensure compatibility.
- .6 Roofing and sheet metal work shall be performed in conformance with the roofing manufacturer's written recommendations, as well as the requirements of the ULC laboratories, Factory Mutual FM-190 and CGSB 47-GP-56M (latest).
- .7 The manufacturer of elastomeric bitumen products shall provide proof of ISO9001 Certification.

1.7 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 Health and Safety Requirements.

1.8 Product Delivery, Storage & Handling

- .1 Deliver and store all materials in their original containers in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, CSA and other references to accepted standards clearly shown.
- .2 Store materials in weatherproof shelters, having floors which will protect the materials from moisture. Store rolled materials on ends. Avoid prolonged exposure of light and heat sensitive materials to sunlight. Remove only as much material from storage as can be applied and made weathertight in the same day.
- .3 Do not place roof insulation in direct contact with the earth, road surface, or roof deck. Place suitable supports under the insulation upon delivery to protect it from absorbing dampness.
- .4 Do not store materials in concentrations which exceed design live load.
- .5 In the event material is damaged by the elements, improper handling or other causes, such material will be rejected and shall be replaced at no extra cost to the Departmental Representative.
- .6 Place plywood runways over completed Work to enable movement of material and other traffic.
- .7 Store sealants at +5 degrees C minimum.
- .8 Handle roofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

1.9 Protection

- .1 Respect safety measures described in the manufacturer's written directives, as well as RCABC written recommendations.
- .2 At the end of each work day, use an infrared detector to spot any smouldering or concealed fire. Job planning must be organized to ensure workers are still on location at least one hour after torch application.

- .3 Never apply the torch directly to dry wood surfaces. Comply with the fire safety recommendations of the manufacturer and the RCABC.
- .4 Throughout roofing installation, maintain a clean site and have one approved ABC fire extinguisher within 6 meters of each roofing torch. Respect all safety measures described in technical data sheets. Torches must never be placed near combustible or flammable products.

1.10 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with Laws and regulations.
- .7 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
- .8 Ensure emptied containers are sealed and stored safely.
- .9 Divert unused materials from landfill to recycling facility as approved by Departmental Representative.
- .10 Unused adhesives, sealant, and asphalt materials must not be disposed on into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .11 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

1.11 Co-Operation with Other Trades

- .1 Advise all other trades of their responsibility in having pipes, sleeves, A/C unit fan, and cowl bases installed on the roof in adequate time so that the roofing work is not delayed. Coordinate roofing with mechanical and electrical trades.
- .2 The mechanical trades shall be responsible for cap and counterflashing of any ducts, vents, stacks, or other sheet metal projecting through the roof. This section shall provide base flashing over wood or metal curbs, etc., and seal lead flashings for service lines into the roof members.
- .3 Coordinate work of this Section with that of Section 07 10 00 for that Section's application of Fluid Applied Waterproofing over SBS cap sheet for collection of potable water.

1.12 Job Conditions

- .1 Conform to the ambient air temperature and humidity requirements and limitations as set forth by the membrane system manufacturer, the RCABC and the Roofing Inspection Agency for installation of all systems and materials.
- .2 Minimum installation air temperature for solvent-based adhesives and compounds is (-) 5 degree C.
- .3 Protect roof decks from damage due to roofing or sheet metal operations. Protect work of other trades from damage; replace and/or make good any and all such damages caused by work of this section.
- .4 Protect all adjacent surfaces and work during roofing from damage, with special protection adjacent to hoist.
- .5 Inspect surfaces to receive work of this section and report any defects in writing to the Departmental Representative.
- .6 Commencement of work will imply acceptance an approval of such surfaces and no claim for defects in workmanship will subsequently be allowed.
- .7 Provide all temporary tarps and structures, at no additional cost to the Departmental Representative, required to protect building and roofing from weather conditions, which may cause a delay in meeting project schedules.

1.13 Inspection & Warranties

- .1 The Contractor shall, at no additional cost to the Departmental Representative, arrange for the supplier/manufacturer of the membrane system, to inspect the work in progress after base sheet installation and during seaming, and upon completion, to ensure that the complete system is installed in full compliance with the supplier's/manufacturer's specifications, recommendations, and details.
- .2 There will be no Installation Guarantee for work of this section. However, there shall be roof inspection services. Roof inspection shall be performed by an independent inspection agency appointed by the Departmental Representative. Costs for inspections and warranty shall be paid for by the Contractor. Inspection service shall include additional inspection of roof immediately prior to interim completion of this Contract.
- .3 The Contractor shall co-operate with the appointed inspection agency; provide material samples when requested and provide access to the work in progress.
- .4 The Contractor shall obtain from the manufacturer of the elastomeric bitumen membrane system, a written warranty stating that its products are free of manufacturing defects and shall provide a waterproof surface for 20 years after installation. If infiltration happens due to faulty material, the manufacturer shall make the necessary repairs, at its expense.

PART 2 PRODUCTS

2.1 Component Compatibility

- .1 Ensure that all components of the membrane systems are compatible. All

membrane, accessories and associated mastic/sealant compounds shall be products of the same manufacturer.

2.2 Vapour Barrier

Refer to Section 07 26 00 Vapour Retarders

2.3 Roof Insulation (Base Layer)

- .1 High strength moulded closed cell polyisocyanurate foam core integrally laminated to heavy, black, non-asphaltic fibre reinforced glass facers, adhered to substrate.
- .2 Insulation shall conform to CAN/ULC-S704-2001 Const No. C34 and CAN/ULC-S770-2000 for determination of long term thermal resistance of closed cell insulating forms and shall meet or exceed the physical property values from the following table:

PROPERTY	TEST METHOD	VALUES
Dimensional Stability (Length and Width)	ASTM D2126	<2%
Compressive Strength (10% Deformation)	ASTM D1621	140 kPa
Water Absorption	ASTM C209 ASTM D2842	<1% <3.5%
Moisture Vapour Transmission	ASTM E96	<1.5 perm (85.0 ng/(Pa•s•m ²))
Product Density	ASTM D1622	Nominal 32.04 kg/m ³
Flame Spread	ASTM E84 (Full 10 min. Test)	25-50**
Smoke Developed	ASTM E84 (Full 10 min. Test)	50-170**
Tensile Strength	ASTM D1623	>35 kPa
Service Temperature	-	-73 to 122°C

- .3 Insulation shall be engineered factory-tapered to create crickets, back slopes and where indicated. Insulation shall be applied in 2 layers to yield an effective R value of 36 to 40. Add extra layer to achieve roof slops.

2.4 Mineral Fibre Insulation Protection Layer

- .1 Mineral wool board, made from basalt rock and slag, with bitumen-impregnated rigid upper face compatible with roofing membranes and resistant to torch application of base roofing ply.
- .2 Applied as top layer (75 mm thick) over base layer of polyisocyanurate insulation as protection from “insulation creep” and complying with following Table of

Properties:

Property	Test Method	Values
Thermal Resistance (RSI Value – m ² K/W for 25.4 mm at 75°F)	ASTM C518 (C177)	0.68 m ² K/W (R-3.8 hr ft ² F / BTU for 1 in 75°F)
Compressive Strength		
- Top Layer at 10%	ASTM C165	139 kPa (20.2 psi)
- Top Layer at 25%		252 kPa (37.0 psi)
- Entire Board (3 in Thickness) at 10%	EN 12430	71 kPa (10.3 psi)
- Entire Board (3 in Thickness) at 25%		103.5 kPa (150 psi)
- Point load at 5 mm compression		205 kPa (30.0 psi)
Density		
- Top Layer	ASTM C612-09	13.75 lb/ft ³ (22 kg/m ³)
- Bottom Layer		10.0 lb/ft ³ (160 kg/m ³)
* Formed as a monolithic structure		
Dimensional Stability, Linear Shrinkage 24 hours at 1200°F (650°C)	ASTM C356	0.71%
Water Absorption	ASTM C209	<1.0%
Water Vapor Sorption	ASTM C1104	0.15%

- .3 Accepted products:
- .1 “Soprarock DD Plus” by Soprema.
 - .2 “Toprock DD Plus” by Roxul.
 - .3 Other products with the same demonstratable characteristics will not be excluded.

2.5 Adhesive

- .1 Adhesive for securing roof insulation: two-part polyurethane foamed adhesive as acceptable to manufacturers of all components to be bonded and to RCABC.
- .2 Accepted product: “Duo Tack” by Soprema Waterproofing. Other products having the same characteristics will not be excluded.

2.6 Membranes

.1 All membranes must meet or exceed ASTM D6162, CSA A123.21-10, FM4470, CAN/CGSB 37.56 M, ULC-S107.

.2 Base Sheet (and Base Stripping Ply at Non-Combustible Substrates):

.1 Membrane shall be composed of a composite reinforcement and SBS modified bitumen, 2.5 mm thick, with both faces covered with a thermofusible plastic film. This membrane shall be torch-applied.

.2 Reinforcement: composite.

.3 Elastomeric asphalt: mix of selected bitumen and minimum 12% SBS thermoplastic polymer.

.4 Physical properties: (as per CAN/CGSB-37.56-M, 9th Draft)

Properties	MD	XD
.1 Strain energy	7.8 kN/m	7.2 kN/m
.2 Breaking strength	15 kN/m	13.5 kN/m
.3 Ultimate elongation	60%	65%
.4 Tear resistance		125 N
.5 Static puncture resistance		560 N
.6 Dimensional stability	0.2%	0%
.7 Plastic flow	≥110°C (230°F)	
.8 Cold bending at -30°C (-22°F)	No cracking	
.9 Lap joint strength	Pass > 4 kN/m	

.5 Accepted product: "Sopraply Base 520" by Soprema Waterproofing. Other products having the same characteristics will not be excluded.

.3 Self-Adhesive Membrane:

(Base Stripping Ply at Combustible Substrates and Where Required)

.1 Membrane shall be self-adhesive SBS modified bitumen, with composite reinforcement, covered with a thermofusible plastic film. Membrane shall be available in both summer and winter grades. Thickness: 3.0 mm.

.2 Physical properties: (as per CAN/CGSB-37.56-M, 9th Draft)

.1	Strain energy, MD/XD (kN/m)	7.8 / 7.2
.2	Breaking strength, MD/XD (kN/m)	15 / 13.5
.3	Ultimate elongation, MD/XD (%)	60 / 65
.4	Tear resistance (N)	125
.5	Static puncture (N)	560
.6	Cold bending (C) - Initial	-30
	- 90 days at 70°C	-30

.3 Accepted product: "Sopralene Flam Stick" by Soprema Waterproofing.

Other products having the same characteristics will not be excluded.

.4 Cap Sheet:

- .1 3.7 mm thick Styrene Butadiene Styrene (SBS) high performance membrane shall have a composite reinforcement and thermofusible elastomeric asphalt. Under side shall be protected by a thermofusible plastic film. This membrane shall be applied by torching only. Top surface of membrane shall be covered with highly reflective white granules. Membrane shall be factory-treated with fire retardant.
- .2 Membrane shall have a minimum SRI of 86 regarding heat island.
- .3 Physical Properties: (as per CAN/CGSB-37.56-M, 9th Draft).

Properties	MD	XD
.1 Strain energy	11.9 kN/m	9.5 kN/m
.2 Breaking strength	19.5 kN/m	15.1 kN/m
.3 Ultimate elongation	61%	75%
.4 Tear resistance	70 N	
.5 Static puncture resistance	470 N	
.6 Dimensional stability	-0.2%	0.1%
.7 Plastic flow	≥110°C (230°F)	
.8 Cold bending at -30°C (-22°F)	No cracking	
.9 Lap joint strength	Pass > 4 kN/m	
.10 SRI (ASTM E1980)	86	

- .4 Accepted product: "Supratar Flam HDGR FR" by Soprema Waterproofing. Other products having the same characteristics will not be excluded.

.5 Cap Stripping Ply

- .1 4.0 mm thick Styrene Butadiene Styrene (SBS) high performance membrane shall have a composite reinforcement and thermofusible elastomeric asphalt. Under side shall be protected by a thermofusible plastic film. This membrane shall be applied by torching only. Top surface of membrane shall be covered with highly reflective white granules. Membrane shall be factory-treated with fire retardant.
- .2 Physical Properties: (as per CAN/CGSB37.56-M, 9th DRAFT)

Properties	MD	XD
.1 Strain energy	7.8 kN/m	7.2 kN/m
.2 Breaking strength	15 kN/m	13.5 kN/m
.3 Ultimate elongation	60%	65%
.4 Tear resistance	125 N	
.5 Static puncture resistance	560 N	
.6 Dimensional stability	0.2%	0%

- .7 Plastic flow ≥110°C (230°F)
- .8 Cold bending at -30°C (-22°F) No cracking
- .9 Lap joint strength Pass > 4 kN/m

.3 Accepted product: “Sopraply Traffic Cap FR 561” by Soprema Waterproofing. Other products having the same characteristics will not be excluded.

2.7 Acceptable Products

- .1 Soprema.
- .2 Siplast.

2.8 Catalyzed Resin Liquid Flashing System

.1 Multi-component, fully reinforced, flexible polymethyl methacrylate-based (PMMA) liquid flashing membrane system by same manufacturer as roofing membranes and complying with the following Table of Properties.

Property	Test Method	Values
Membrane thickness	ASTM D5147 Sec 5	2.9 mm (115 mils)
Peak load @ 23°C (73°F) avg.	ASTM D5147 Sec 6	12.3 kN/m (70 lbf/in)
Elongation @ peak load, avg.	ASTM D5147 Sec 6	42%
Peak load @ 23°C (73°F) avg.	ASTM D412 (dumbbell)	15.8 kN/m (90 lbf/in)
Elongation @ peak load, avg.	ASTM D412 (dumbbell)	55%
Shore A hardness, avg.	ASTM D2240	81
Water absorption, (Method I) (24h @ 23°C (73°F))	ASTM D570	0.41%
Water absorption, (Method II) (48h @ 50°C (122°F))	ASTM D570	1.57%
Low temperature flexibility	ASTM D5147 Sec 11	-25°C (-13°F)
Dimensional stability (max. movement)	ASTM D5147 Sec 10	-0.063%
Tear strength	ASTM D5147 Sec 7	0.5 kN (107 lbf)

- .2 Liquid flashing shall be available in “summer” and “winter” grades, be supplied with companion primer for non-metallic substrates, catalyst and fleece reinforcement. Employ where noted and required.
- .3 Accepted product: “Alsan RS230 System” by Soprema or equal product produced by Siplast.

2.9 Sealants

- .1 As approved by membrane system manufacturer and by RCABC as being compatible with membrane system.
- .2 Plastic cement: asphalt, to CAN/CGSB-37.5 coal tar, to CGSB 37-GP-19M.
- .3 Sealing compound: to CAN/CGSB-37.29, rubber asphalt type.
- .4 Refer to section 07 90 00 – Sealants.

2.10 Fasteners and Accessories

- .1 Fasteners for mechanically fastening fire barrier sheathing board to steel roof deck shall be wind uplift and corrosion-resistant type as recommended and acceptable to the board manufacturer and to RCABC.
- .2 Fire Protection Tape: Fire retardant treated, 165 mm wide tape, composed of glass fleece reinforcement and SBS bitumen. The top side is sanded and the bottom side is covered with a silicone release film.
- .3 Splash Blocks: for use where scuppers from elevated roofs spill onto main roof. 600 x 600 x 50 mm stock pre-cast lightweight concrete patio pavers.

PART 3 EXECUTION

3.1 Workmanship - General

- .1 All workmanship shall be at least in accordance with RCABC standards for a 10 year guarantee for the various systems described.
- .2 Use materials and systems in accordance with manufacturer's specifications and instructions.
- .3 Leave no work exposed during unsettled weather. Glaze and finish membranes at end of each work period, to direction of roofing inspector.
- .4 Work to; and around all features, voids and edges, in best trade manner to produce watertight and weatherproof insulation.
- .5 Follow approved stripping and membrane flashing methods at eaves, curb, parapets, etc., in accordance with RCABC system guidelines.
- .6 All seams of granular surfaced cap membranes and wall covering shall be carefully heat welded with propane torch. No visible bleed-out of bitumens will be accepted. Bleed-out at joints shall be covered with granular material to match cap sheets. Surfaces when completed shall present a neat, even appearance.
- .7 Apply only as much insulation to the roof as can be covered the same day with roofing membrane. At the conclusion of each day's work, seal exposed edges of the roof insulation. This seal shall be cut and lifted upon continuation of the work.
- .8 Do priming for modified asphalt roofing in accordance with CGSB 37-GO-15M.

3.2 Examination of Roof Decks

- .1 Before commencing roofing work, this section, together with the Departmental Representative and the Contractor, shall inspect all surfaces scheduled to receive membranes for condition, slopes, nailing supports, sheetmetal parapet

facing, roof drains, stack vents, mechanical and electrical penetrations, building joints, etc.

- .2 All surfaces must be smooth, dry, clean and free of ice and debris. No salt or calcium shall be used to remove snow or ice.
- .3 Surfaces scheduled to receive membranes must possess a smooth surface with an even finish; free of excessive moisture, ridges, hollows and sharp corners.
- .4 If defects are found, a non-compliance notice will be issued to the Contractor so that adjustments can be made. Proposals for correction of defects shall be submitted to the Departmental Representative for approval.
- .5 Corrections of defects shall be made at no additional cost to the Departmental Representative using materials which adhere to the substrate, are stable, do not deform under traffic loads and are compatible with bituminous materials. The deck must be clean, dry, and free of contamination by treatment products, lubricating oils, diesel oil or grease, which could affect the adhesion of the waterproofing or the physical integrity of the membrane itself.
- .6 Commencement of roofing/waterproofing work shall imply acceptance of surfaces and conditions.

3.3 Preparation

- .1 Supply to the various sections concerned in ample time: all inserts, reglets, and accessories required to be built into the work of other sections. Instruct as to the proper location and position of such items.
- .2 Co-operate with, and coordinate work with Mechanical trades and other providers of interfacing materials and systems to ensure watertight junctions at roof drains, vents, and other items passing through the roof.
- .3 Minimize exposure of the roof deck to the elements by proceeding as soon as the roof deck is completed. Do not work during rain, fog, sleet, ice, or snow. Warm roofing materials before using in cold weather.
- .4 Sweep clean and remove all debris from roof deck surfaces before commencement of work.

3.4 Equipment

- .1 Maintain all equipment and tools in good working order.
- .2 Use torch types recommended by the manufacturer of the elastomeric asphalt membranes, and acceptable to RCABC and ULC.

3.5 Roofing System Descriptions

- .1 Roof Assembly Type 'R1' (Class A-Insulated):
 - .1 6 mil Poly Vapour Barrier
 - .2 13mm Protection Board
 - .3 Two layers polyiso roof insulation, total R Value 36 to 40, adhesive-applied, factory-tapered at crickets and back-slopes.
 - .4 One-layer 100 mm mineral fibre insulation/protection, (R11.5), adhesive-

applied with joints staggered from those of previous layer.

- .5 Base sheet torch-applied.
- .6 Granular cap sheet torch-applied.
- .7 Stripping and membrane flashing, granular-surfaced where exposed to view.
- .8 All Parapets and Vergers:
 - .1 Prepare and prime sheetmetal parapet facing.
 - .2 Torch-applied base stripping ply full height
 - .3 Granular cap sheet torch-applied

3.6 Combination Fire Barrier Sheathing Board/Vapour Barrier Installation

- .1 Install board with long side of sheet resting on and perpendicular to direction of flutes in deck. Short side shall rest on top of flute. Ensure edges are butted tightly.
- .2 Stagger end joints a minimum of 600 mm.
- .3 Secure board in place with self-drilling non-corrosive screws and companion plates applied at the spacing specified by the board manufacturer and acceptable to RCABC.

3.7 Primer Application

- .1 Apply all primers in accordance with the manufacturer's directions to all surfaces prior to application of membranes and other roofing components.

3.8 Fire Retardant Tape Application (where required)

- .1 Prior to the application of any torch on base sheet materials, install a width of tape over substrate cracks, voids in the construction, angle changes at curbs, parapets, penetrations, walls, and penetrations to prevent contact of flame with combustible materials or construction debris.

3.9 Insulation Installation

- .1 Insulation: adhesive application.
 - .1 Apply insulation in following order: polyisocyanurate in 2 layers with staggered joints and 75mm mineral fiber top layer.
 - .2 Adhere insulation to substrate and preceding layers using adhesive applied in accordance with manufacturer's instructions, Factory Mutual and RCABC requirements.
 - .3 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .4 Cut end boards to suit.

3.10 Membrane Application

- .1 Base sheet application:
 - .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
 - .2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
 - .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
 - .4 Application shall be free of blisters, wrinkles and fishmouths.
- .2 Cap sheet application:
 - .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
 - .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
 - .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
 - .4 Application shall be free of blisters, fishmouths and wrinkles.
- .3 Membrane Flashing (Stipping Plies) Application:
 - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Apply base and cap sheet onto substrate in 1 meter wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Torch-weld cap stripping ply and base stripping at non-combustible substrates. Self-adhesive-apply base stripping to combustible substrates.

3.11 Interim Completion Inspection

- .1 Inspect the roofs at or just before the date of substantial completion. Remove all nails and other debris which will cause damage to roof membranes. Ensure the roof has not been damaged by construction activities and the interfacing with the existing roof membrane system is complete and free of any defects. Leave the entire roof ready for final inspection by Inspection Company.
- .2 Provide the Departmental Representative with a written certificate that this inspection has been completed.

3.12 Adjust and Clean

- .1 Repair, remove and clean all drips or smears of adhesive and asphalt on

exposed finished surfaces or surface to be subsequently finished. Clean off immediately as directed by Departmental Representative.

- .2 As the work progresses and at completion of the work, clean up and remove from the site, all rubbish and debris resulting from roofing and sheet metal work.

END OF SECTION

Part 1 GENERAL

1.1 Related Sections

1. Section 07 27 13 Self-Adhered Membrane
2. Section 07 42 43 Composite Wall Panel System
3. Section 07 52 00 Modified Bituminous Membrane Roofing
4. Section 07 90 00 Sealants

1.2 References

1. American Society for Testing and Materials (ASTM International).
 - .1 ASTM A653/A653M03, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. Roofing Practices Manual as published by the Roofing Contractors Association of British Columbia.
3. Sheet Metal and Air Conditioning Contractor's National Association, Inc., "Architectural Sheet Metal Manual" (SMACNA).

1.3 Submittals

1. All submittals shall be in accordance with Div 1 – Submittal Procedures.
2. Samples:
 - .1 Submit 100 x 150 mm samples of each type of sheet metal material, colour and finish.

Part 2 PRODUCTS

2.1 Exposed Cap Flashing (Parapets & Guardwalls)

1. Provide zinc cap flashing under provisions of Section 07 42 00 Metal Wall Panel.

2.2 Sheet Flashing Materials

1. Powder coated finish steel sheet: Commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, shop-spray-painted with a PPG Fluoropolymer coating (refer to Section 09 90 00 – Painting and Coating). Colour as selected by Consultant to match interfacing wall panels.

- .1 Metal thickness shall be minimum 24 gauge, but adjusted to accommodate use and span in order to yield a smooth, non oil-canned surface.
2. Aluminum sheet: proprietary minimum 22 gauge utility sheet, plain pattern, to CAN/CGSB 93.1 clear anodized to match aluminum composite wall panels and glazing systems where associated with those systems.
3. Flashing associated with Aluminum cladding to custom match colour and finish
4. Flashing associated with Aluminum Curtain wall to match colour and finish

refer to section 4073-074200 Metal Wall Panels, Also refer to appendix A for products and finishes

2.3 Accessories

1. Isolation coating: alkali resistant bituminous paint.
2. Plastic cement: to CAN/CGSB 37.5.
3. Self-adhered Membrane: as per Section 07 27 13.
4. Sealants: In accordance with Section 07 92 00.
5. Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
6. Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
7. Washers: of same material as sheet metal, 1 mm thick with rubber packings.
8. Touch-up paint: as recommended by prefinished material manufacturer.

2.4 Fabrication

1. Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC details, SMACNA details and as indicated.
2. Form pieces in 2438 mm maximum lengths. Make allowance for expansion at joints.
3. Hem exposed edges on underside 13 mm. 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 and Formed Sheet Metal

1. Form flashings, copings, cap flashings and fascias to profiles indicated from minimum 24 gauge material. (22 gauge for aluminum).
2. Form reglets, gum pockets, clamping bars and other members shown on drawings from zinc alloy of sufficient thickness to safely produce a weather tight seal with workmanlike appearance.
3. For roof edge metal upstands ("Sheet Metal Parapet") or other descriptions noted on drawings from minimum 1.22 mm thick galvanized steel or as otherwise noted thickness on drawings.

2.6 Fasteners

- .1 Steel pan head screws with fine thread for metal. Can be self tapping or self drilling.
- .2 #8 x 1/2" (minimum) long stainless steel suitable for metal flashing application. Stainless to be 300 Series when exposed- otherwise 300 or 400 Series is acceptable.
- .3 For exposed conditions use pan head stainless steel screws, with neoprene washer, heads coloured to match flashing.

2.7 Overflow Scuppers

1. Form scuppers from min. 22 gauge thick material.
2. Sizes and profiles as indicated and as per requirements of RCABC and SMACNA.
3. Provide necessary fastenings.

Part 3 EXECUTION

3.1 Installation

1. Install sheet metal work in accordance with RCABC details, SMACNA details and as indicated.
2. Use concealed fastenings except where approved before installation.
3. Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock seams forming tight fit over hook strips, as detailed.

4. Use standing seams at corners.
5. Lock end joints and caulk with sealant.
6. Install surface mounted reglets true and level, and caulk top of reglet with sealant.
7. Insert metal flashing into reglets and under cap flashings to form weather tight junction.
8. Turn top edge of flashing into recessed reglet or mortar joint minimum of 1". Lead wedge flashing securely into joint.
9. Caulk flashing at reglet and cap flashing with sealant.
10. Install head & sill flashings at windows & doors in one continuous piece whenever possible.
11. Install flashings lapped "shingle" style with membranes to divert water to the exterior.
12. Install all flashings so that all surfaces have a minimum slope of 1:4 to the exterior.
13. Extend flashing min. 13mm past all cladding, complete with a drip-edge.

3.2 Installation of Scuppers

1. Install scuppers as indicated and to requirements of RCABC and SMACNA.

END OF SECTION

1.1 General

1.2 RELATED REQUIREMENTS

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.3 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115 (latest edition) Fire Tests of Fire stop Systems.

1.4 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings:
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .3 Closeout Submittals:
 - .1 Contractor shall provide certificate of completion for firestopping that all firestopping has been installed in accordance with manufacturer's written instructions. Incorporate into Operations and Maintenance Manual.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: person specializing in fire stopping installations approved by manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating: to match existing.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.
- .11 Standard of acceptance: Hilti, 3M, or approved alternate.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.
- .6 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Edge of floor slabs at curtain wall and precast concrete panels.
 - .3 Top of fire-resistance rated masonry and gypsum board partitions.
 - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

- .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: not required.

3.5 FIELD QUALITY CONTROL

- .1 Consultant's Review: notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
 - .1 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

PART 1 GENERAL

1.1 Summary

- .1 This section specifies standards for caulking and sealants applied by this and other sections.
- .2 Refer to other sections for additional caulking and sealants.

1.2 Reference Standards

- .1 CAN/CGSB-19.13-M87 Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .2 CGSB 19-GP-14M-76 Sealing Compound, One Component, Butyl-polyisobutylene Polymer Base, Solvent curing.
- .3 CAN/CGSB-19.17-M90 One-Component Acrylic Emulsion Base Sealing Compound.
- .4 CAN/CGSB-19.21-M87 Sealing and Bedding Compound Acoustical.
- .5 CAN/CGSB-19.22-M90 Mildew Resistant, Sealing Compound for Tubs and Tiles.
- .6 CAN/CGSB-19.24-M90 Multi-component, Chemical Curing Sealing Compound.

1.3 Environmental and Safety Requirements

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets acceptable to Labour Canada.
- .2 Comply with requirements specified in the following sections:
 - .1 Division 1 – Environmental Procedures
 - .2 Division 1 – Waste Management and Disposal
- .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .4 Sealant and substrate materials to be minimum 5° C.
- .5 Should it become necessary to apply sealants below 5° C, consult sealant manufacturer and follow their recommendations.

1.4 Waste Management and Disposal

Separate waste materials for reuse and recycling in accordance with Division 1 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Sealant Materials

- .1 Sealants acceptable for use on this Project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 Sealant Material Designations

- .1 Urethanes One Part.
 - .1 Self-Levelling to CAN/CGSB-19.13, Type 1, colour as selected.
 - .2 Non-Sag to CAN/CGSB-19.13, Type 2, MCG-2-40, colour as selected.
 - .3 Acceptable materials:
 - .1 Tremco Dymonic 100.
 - .2 Tremco Dymonic FC.
 - .3 BASF Masterseal NP1.
- .2 Silicones One Part.
 - .1 Single component neutral cure silicone to CAN/CGSB 19.13.
 - .2 Acceptable materials :
 - .1 Dow Corning 795 (where both sides consist of nonporous surfaces)
 - .2 Dow Corning 790 Low modulus (where both sides consist of cementitious substrates)
- .3 Air Barrier Sealant (for poor bonding surfaces). To adhere to spun bonded polyolefin and fibrous or woven air barrier sheet material and poly faced self adhered membranes.
 - .1 Acceptable material: Dow Corning 758
- .4 Acoustical Sealant
 - .1 To CAN/CGSB-19.21
- .5 Butyl Sealant
 - .1 Noncuring, flexible polyisobutylene sealant.
 - .2 Acceptable products: Tremco Butyl sealant.
- .6 Acrylic Latex One Part.
 - .1 To CGSB 19-17.
- .7 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.

- .2 Size: oversize 40 to 50%.
- .2 Neoprene or Butyl Rubber
 - .1 Round solid of Shore A hardness 70.
- .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
- .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape, which will not bond to sealant.

2.3 Sealant Selection

- .1 Perimeters of exterior openings where frames meet exterior façade of building: Sealant type: one component Silicone, non-sag.
- .2 Coping joints and coping-to-façade joints & flashing joints: Sealant type: butyl.
- .3 Interior control and expansion joints in floor surfaces: Sealant type: one component urethane self-levelling.
- .4 Countertops (e.g. sinks, urinals, basins, vanities): Sealant type: silicone, mildew resistant.
- .5 Exposed interior control joints in drywall: Sealant type: acrylic latex.
- .6 Concealed joints in sound attenuated walls and ceilings: Sealant type: acoustic.
- .7 Colour of sealants: selected by Consultant from manufacturer's standard range to match adjacent surfaces.
- .8 Joint cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.4 Joint Cleaner

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

PART 3 EXECUTION

3.1 Preparation of Joint Surfaces

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil, grease, and other matter which may impair work.

- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility in materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.2 Priming

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

3.3 Back Up Material

Apply bond breaker tape where required to manufacturer's instructions.

Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.4 Mixing

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

3.5 Application

- .1 Sealant.
 - .1 Apply sealant in accordance with manufacturer's written instruction.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .2 Apply sealant in continuous beads.
- .3 Apply sealant using gun with proper size nozzle.
- .4 Use sufficient pressure to fill voids and joints solid.
- .5 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .6 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .7 Remove excess compound promptly as work progresses and upon completion.
- .8 Curing.
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.
- .9 Cleanup.
 - .1 Clean adjacent surfaces immediately and leave work neat and clean.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses,
 - .3 Remove masking tape after initial set of sealant.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 07 92 00 Joint Sealants
- .2 Section 08 71 00 Door Hardware
- .3 Section 09 90 00 Painting and Coating

1.2 Reference Standards

- .1 A924/A924M-99 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 A653/A653M-02A Standard Specification for Steel Sheet, zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the hot-Dip Process.
- .3 A1011/A1011M-03 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon Structural, High Strength low-Alloy and high Strength Low-Alloy with improved Formability.
- .4 A1008/A1008M-03 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, high-Strength Low-Alloy and high-Strength Low-Alloy with Improved Formability.
- .5 C665-01e1 Standard Specification for mineral-fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .6 CAN/CSA G40.21-M1998 Structural Quality Steels.
- .7 CAN/CGSB-1.18-99 – Ready Mixed Organic Zinc-Rich Coating.
- .8 CAN/ULC-S705.1-2001 – Thermal Insulation Spray Applied Rigid Polyurethane foam, Medium Density, material Specification.
- .9 CSDFMA – Specifications for Commercial Steel Doors and Frames Canadian Steel Door and Frame Manufacturers' Association 1990.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Division 1.
- .2 Clearly indicate each type of door and frame, material core thickness, mortises, reinforcements, anchorages, glazing, location of exposed fasteners and hardware arrangements. Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.

PART 2 PRODUCTS

2.1 Materials

- .1 Sheet Steel (WGSC): tension leveled steel to STMA924M) galvanized to ASTMA653M, commercial steel (CS), type B, coating designation ZF120 (paintable Galvaneal).
- .2 Hot rolled Carbon Steel Sheet (HRCS): commercial quality to ASTM A1011, for concealed reinforcement for materials, 2.7 mm minimum thickness.
- .3 Cold rolled carbon steel sheet (CRCS) commercial quality to ASTM A1008, shop prime coated.
- .4 Bituminous paint: to CAN/CGSB-1/108.

2.2 Components

- .1 Frames: base thickness steel as follows:
 - .1 Interior: 1.6 mm steel having a strike bucket which will accept a 25mm throw deadbolt. Wedge in the area of the strike bucket to prevent spreading; Exterior: 1.6 mm steel having a strike bucket which will accept a 25mm throw deadbolt. Grout in the area of the strike bucket to prevent spreading.
- .2 Doors: base thickness steel as follows:
 - .1 Interior: Hollow-core, metal, 45mm thick with 1.2 mm CRS; Exterior: Hollow-core, metal, 45mm thick with 1.2 mm CRS.
- .3 Frame floor anchors and channel spreaders: minimum 1.6 mm thick base steel.
- .4 Guard boxes: minimum 0.8 mm thick base steel.
- .5 Steel frame anchors:
 - .1 Thickness and design listed by ULC for labeled door and frame assemblies.
 - .2 Stud walls: Twist in stud anchor with base anchor for commercial doors.
- .6 Hinge, lock, strike, flush bolt and surface applied hardware reinforcing: 3 mm minimum base metal thickness. Prepare doors and frames to accommodate hardware specified in Section 08 71 00.
- .7 Hinge, lock, strike, flush bolt and surface applied hardware reinforcing: 3 mm minimum base metal thickness.
- .8 Door bumpers: black neoprene single stud.
- .9 Reinforcing channel: to CAN/CSA G40.21-M, Type 300 W.
- .10 Primer: to CGSB 1-GP-181M, zinc rich.
- .11 Top caps: galvanized steel for all exterior doors, 0.9 mm base metal thickness.

2.3 Door Types

- .1 (HCM) Doors: flush steel with full honeycomb core of 25mm size bonded resin – impregnated kraft reinforcement, with reinforcement for hardware.

- .2 (ICM) exterior flush doors: of same construction as HCM door except with bonded core of polyurethane or isocyanurate board insulation to CAN/ULC-S705.2, RSI 1.9 minimum, with all steel hardware reinforcements and complete with steel top cap.

2.4 Fabrication

- .1 Fabricate doors and frames as detailed: in accordance with Canadian Steel Door and Frame Manufacturer's Association (CSDFMA) "Canadian Manufacturing for Steel Doors and Frames", 1990; for hollow steel construction; ULC requirements and reviewed shop drawings except where specified otherwise. Fabricate frames for glazing, setup and welded in similar manner as for door frames.
- .2 Mortise, reinforce, drill and tap doors and frames and reinforcements to receive hardware using templates provided by finish hardware supplier. Refer to Section 08 71 00.
- .3 Touch up galvanized finish damaged during fabrication.

2.5 Frames

- .1 Cut mitres and joints accurately and weld continuously on inside of frame profile.
- .2 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .3 Protect strike and hinge reinforcements in grout filled frames in masonry walls using guard boxes welded to frames.
- .4 Weld in two channel spreaders per frame, to ensure proper frame alignment.
- .5 Provide Z type snap-in stud type anchors for fixing at floor. All frames in masonry walls with Tee wire type anchors.
- .6 Reinforce head of frames wider than 1220mm; reinforce exterior frame assemblies to resist wind loading.
- .7 Install 3 bumpers on strike jamb for each single door and 2 bumpers at head for pairs of doors.

2.6 Doors

- .1 Assemble components using spot or arc welding.
- .2 Continuously weld longitudinal door edges, fill and grind smooth to conceal edge seams, Mechanical locked open seams no acceptable.
- .3 Equip exterior doors with flush steel top caps to prevent water accumulation.
- .4 Provide 3 mm thickness astragal for double doors predrilled and shipped loose.
- .5 Touch up doors with primer where galvanized finish damaged during fabrication.

PART 3 EXECUTION

3.1 Frame Installation

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreaders at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.
- .4 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .5 Fill frames with loose mineral wool thermal insulation at all exterior doors.

3.2 Door Installation

Install doors and hardware in accordance with hardware templates and manufacturer's instructions. Adjust operable parts for correct function.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Engineered design, shop fabrication and installation of:
 - .1 Aluminum Curtainwall systems;
 - .2 Integral Storefront door;
 - .3 Separate Aluminum Sliding Entrances;

including glazing, extruded deflection head channels, associated flashings and closures, sill covers, anchorage, fixing of fasteners, compressible foam gasketing, caulking within frames and adaptors/coupling for interfacing with other components.

1.2 Related Work

- | | | |
|----|------------------|----------------------------|
| .1 | Division 1 | Quality Control |
| .2 | Section 05 50 00 | Metal Fabrications |
| .3 | Section 07 21 00 | Building Insulation |
| .4 | Section 07 27 13 | Self-Adhered Membrane |
| .5 | Section 07 62 00 | Sheetmetal Flashing & Trim |
| .6 | Section 07 92 00 | Joint Sealants |
| .8 | Section 08 80 00 | Glazing |

1.3 References

- .1 The current version of the following publications and standards:
 - .1 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - .2 Architectural Aluminum Manufacturers Association (AAMA) 501-05.
 - .3 Glass Association of North America (GANA): Glazing Manual, Engineering Standards, Manual and Laminated Glazing Reference Manual.
- .2 Model National Energy Code for Buildings (NECB).
 - .1 NECB 2015.
- .3 National Building Code of Canada (NBCC), 2015.

1.4 Submittals

- .1 All submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data Sheets:
 - .1 Submit manufacturer's Product data sheets for products proposed for use

in the work of this section.

- .3 Shop Drawings:
 - .1 Shop drawings shall be prepared under the supervision of and shall bear the seal of a professional engineer licensed in British Columbia.
 - .2 Further to requirements of Division 1, indicate with plans, sections, elevations and sufficient full size details, components and methods of assembly, materials and their characteristics relative to their purpose, and other fabrication information including relationships to adjacent systems.
 - .3 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, air barrier transitions to various adjacent building envelope air barrier materials, and provisions for thermal and structural movement between components of this section and adjacent materials.
 - .4 Include description of materials, metal finishing specifications, and other pertinent information.
 - .5 Design loads, typical reactions and support movement allowances, both vertical and horizontal, shall be placed on the shop drawings.
 - .6 Shop drawings shall clearly indicate the specification of materials and, where applicable, indicate installation methods and coordination with other sections.
- .4 Letters of Assurance:
 - .1 The Engineer who seals the shop drawings shall submit to the Departmental Representative, with the initial shop drawings submission, an Assurance of 'Structural Design' and Commitment for 'Field Review' on HRDC Standard Form Schedule S. Written inspection reports of field review shall be submitted to the Consultant promptly as field reviews are made. On completion of the installation the Engineer shall submit to the Consultant an Assurance of Field Review and Schedule S.
- .5 Design Calculations:
 - .1 Submit under seal, calculations prepared by the professional engineer responsible for the preparation of the shop drawings that clearly indicate the following:
 - .1 Design assumptions regarding loadings and seismic design, related to the building code.
 - .2 Which codes and standards calculations are based on.
 - .3 Materials proposed and their allowable shear and bending stresses.
 - .4 Maximum, and minimum tolerances for proposed materials including anchors, holes and spacing.
 - .5 Testing data to confirm compliance with thermal performance and

condensation resistance criteria.

- .6 Analysis for dead, wind, snow and guard loads as required and movements caused by temperature changes, support deflections and building sway.
- .7 Analysis to include anchors, glazing members, structural joints, sealants glass. Show section property computations for framing members and submit full sized drawings.
- .2 Calculations shall be prepared in a clear and comprehensive manner so that they can be easily reviewed. Incomplete or haphazard calculations will be rejected for resubmission.

Samples:

- .1 Submit 450 mm x 450 mm size samples of each type of glass and aluminum framing finishes. If requested, submit 200 mm long samples of typical component sections (head, jamb, sill, meeting rail, and the like), fully assembled, indicating glazing and weatherproof methods.
- .6 Maintenance Instructions:
 - .1 Provide training to the Owner's Representative in the operation and maintenance of the aluminum curtainwall systems. Submit printed copies of maintenance instructions given to the Owner's Representative in accordance with Division 1.
 - .2 Submit maintenance data for cleaning and maintenance of curtain walls for incorporation into the operation and maintenance manuals in accordance with Division 1.
- .7 Test Results Reports
 - .1 Submit valid independent laboratory test reports confirming compliance of proposed system with the specified laboratory test requirements. No work shall be fabricated until laboratory test requirements are demonstrated. Cost of testing shall be included in the work of this Section.

1.5 Delivery, Storage and Handling

- .1 Aluminum members shall be adequately wrapped to prevent damage during construction and shipping operations.
- .2 Aluminum shall be isolated from concrete, mortar, plaster and dissimilar metals with bituminous paint. Framing shall be protected from other building materials during and after installation until acceptance by the Departmental Representative.
- .3 Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .4 Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle material and components to avoid damage. Protect curtainwall material against damage from elements, construction activities, and other hazards before, during and after curtainwall installation.

1.6 Quality Assurance

- .1 Installer Qualifications: Installer experienced (as determined by Consultant) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.
- .2 Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.
- .3 Exterior fenestration assemblies shall comply with the energy conservation requirements of NECB 2015.

1.7 Design

- .1 All design shall be executed under the direct supervision of a professional engineer licensed in British Columbia.
- .2 Design structural performance of glazing systems in accordance with National Building Code of Canada (NBCC), 2015.
- .3 Conform to all Energy Efficient Standards of NECB 2015.

1.8 Curtainwall Performance Requirements

- .1 Design total fenestration system to withstand local positive and negative wind pressures acting normal to all planes of assemblies in accordance with NBCC 2015 requirements including supplements, for a 60 second gust velocity with a probability of return of 1 in 10 years, but not less than the following minimum wind loads:
 - .1 Design wind pressure of 1.03 KPa.
 - .2 Design wind suction of 1.13 KPa.
- .2 Air infiltration: the test specimen shall be tested in accordance with ASTM E283. Air infiltration rate shall not exceed 0.06 cfm/ft² at a static air pressure differential of 6.24 psf.
- .3 Water resistance, (static): The test specimen shall be tested in accordance with ASTM E331. There shall be no leakage at a static air pressure differential of 12 psf as defined in AAMA 501.1.
- .4 Water resistance, (dynamic): The test specimen shall be tested in accordance with AAMA 501.1. There shall be no leakage at an air pressure differential of 12 psf as defined in AAMA 501.1.
- .5 Uniform Load: A static air design load as per NBCC 2015 shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member at design load. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
- .6 Seismic: When tested to AAMA 501.4, system must meet design displacement of 0.010 x the story height and ultimate displacement of 1.5 x the design displacement.

- .7 Condensation Resistance (CRF): When tested to AAMA Specification 1503.1, the condensation resistance factor shall not be less than 75 frame and 67 glass (low-e glass).
- .8 Attend field tests of representative areas of curtain wall selected by Consultant for water penetration by a recognized independent testing agent.
 - .1 Test areas as selected by Departmental Representative, as described in Part 3 of this specification.

1.9 Energy Performance Requirements

- .1 To be determined according to NECB 2015.
- .2 Fixed glazing, operable vents, and doors:
 - .1 Overall U-value: 2.4 W/m²K (0.422 BTU/hr/ft²/°F) or less.
 - .2 Solar Heat Gain Coefficient: 0.4 or less
 - .3 Form of Energy Performance Calculations: Provide WINDOWS computer simulated energy analysis for typical portion of curtain wall shown on drawings.
 - .4 Insulated Spandrel: Overall R value: 15 (ft² · h · °F)/Btu

1.10 Warranty

- .1 Provide a written warranty signed and issued in the name of the Owner stating that the aluminum curtainwall system will meet the performance requirements for a period of two (2) years from the date of Substantial Performance of the project provided, however, that said guarantee shall begin in no event later than six months from shipment date by the manufacturer.

PART 2 PRODUCTS

2.1 Materials

- .1 All materials shall be to ASTM B221 and AAMA / WDMA / CSA 101 / I.S.2 / A440-11. Extrusions shall be 6063-T5 or T6 alloy and temper. Formed aluminum components shall be of gauge, alloy and temper suitable for their application, finish and specified structural requirements.
- .2 Fasteners shall be 300/400 Series Stainless Steel and of sufficient size and quantity to perform their intended function and structural loading.
- .3 Weathering and Glazing Gaskets:
 - .1 To ASTM C864, extruded from a silicone – compatible EPDM rubber which provides for silicone adhesion.
- .4 Glazing tapes shall be macro-poly isobutylene, highly adhesive with continuous built-in shim at windows.
- .5 Thermal Barrier: Thermal break shall be manufacturer's standard strut type and tested in accordance with AAMA 505.
- .6 Perimeter anchors: Aluminum. When steel anchors are used (only use galvanized to G90 min.), provide insulation between steel material and aluminum

- material to prevent galvanic action.
- .7 Aluminum shall have isolation coating where required using Alkali-resistant Bituminous paint using dialectic separators where required.
 - .8 Flashing shall be pre-formed to shapes and profiles shown or as required to insure a waterproof and air tight assembly. Material from aluminum alloy, to match framing/doors were exposed, mill finish elsewhere.
 - .9 Sill flashings shall be back and end dammed and caulked into place, minimum 18 gauge.
 - .10 Glass and Glazing: by type as specified in Section 08 80 00 and noted/scheduled on drawings.
 - .11 Caulking and Sealants: to manufacturer's standard and to standards as specified in Section 07 90 00.
 - .12 Perimeter Membrane: Refer to Section 07 27 13.

2.2 Aluminum Finishes

- .1 Clear Anodized: Exposed aluminum sections shall be given an anodic oxide treatment in accordance with Aluminum Association Specification AA-M12C22A31, AAMA 611, Architectural Class II Clear Anodic Coating.

2.3 Product Source Quality Control

- .1 Provide all aluminum framed glazing systems from a single source manufacturer:

2.4 Fabrication General

- .1 Fabricate components as per manufacturer's instructions from extrusions of size and configuration as indicated on reviewed shop drawings and 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 All joints shall be accurately machined, assembled and sealed to provide a neat and weathertight assembly. Shielded drainage and pressure equalization vents shall be provided where required. All horizontal members shall be sealed to vertical members to provide individual compartments within the system in accordance with the rain screen principle.
- .4 Anchorage for curtainwall framing shall be located within the vertical tube sections or on the tube sides as strap anchors. The anchors shall be designed to allow for the thermal expansion and contraction of the frame. The design of the anchors must not interfere with the adhesion of the air seal membrane from the wall directly to the tube face of the section
- .5 Mechanically retain the perimeter air seal membrane to the tube face of the section with the use of aluminum anti-rotation channel.
- .6 Gaskets and weather seals shall be mechanically keyed in dry glazing systems for both interior and exterior applications (Visionstrip is not considered a

mechanically keyed gasket.)

- .7 For all penetrations of the wall system (windows, doors and louvers): bridge the cavity of the wall by means of flashing (not by the use of the frame or cover cap). Do not caulk cover caps to flashing.

2.5 Aluminum Curtainwall (Standard Capped)

- .1 As detailed, framing shall be 63.5mm X 152.4mm (verify for loading). Reinforce where and as required. All mullions shall be of uniform size. Employ special mullions as required.
- .2 Outside glazed with glass type as scheduled (refer to Section 08 80 00) with a pressure-plate format.
- .3 Provide 18-gauge aluminum sill flashing (finish to match curtainwall) formed as indicated, complete with end and back dams and fixing clips.

Refer to Appendix A for acceptable product.

2.6 Storefront Doors

- .1 Exterior (building) storefront doors are hung, by means of adaptors, in Aluminum Curtainwall System.
- .2 Safety-glazed 57 mm thick thermally-broken tubular extruded aluminum "storefront" swing door with 127 mm stiles, top and lock rails and 304 mm bottom rails.
- .3 Door shall have dual moment welded corner construction and shall accommodate sealed double glazing (refer to Section 08 80 00).
- .4 Hardware: cylinders, mortised panic sets, mortised deadlocks and electric strikes shall be as supplied and scheduled by Section 08 71 00. This section shall supply the following hardware which is also scheduled in Section 08 71 00.
 - .1 Standard ball bearing NRP butt hinges. (Electrified where scheduled).
 - .2 Classic push/pulls where scheduled.
 - .3 Aluminum thresholds.
 - .4 Door closers where scheduled.
 - .5 Bulb polymeric weather stripping.
 - .6 Adjustable astragal pile weather stripping with polymeric fin at meeting stiles.
 - .7 All exterior double and single aluminum storefront doors shall have full-height 3 mm thick aluminum astragals fixed to door stiles with tamperproof screws. Double doors with closers shall have coordinators mounted on interior.
- .5 Provide all aluminum framed glazing systems from a single source manufacturer.

Refer to Appendix A for acceptable product.

2.7 Insulated Spandrel Panel

- .1 all spans with insulated backpan to have a sheet metal finish to match mullion finish and colour.
Refer to Appendix A for finishes and colour.

2.8 Accessories

- .1 Provide thermally broken aluminum thresholds at doors.

PART 3 EXECUTION

3.1 Examination

- .1 Verify that all substrate conditions are acceptable for product installation in accordance with manufacturer's instructions. Verify that openings are sized to receive glazing systems and that sills are level in accordance with manufacturer's acceptable tolerances. Report all unacceptable conditions to Departmental Representative in writing immediately upon discovery.
- .2 Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.2 Installation General

- .1 Install all aluminum glazing systems in strict accordance with manufacturer's written instructions, reviewed shop drawings, specialty engineer's written directive, 2015 National Building Code of Canada, and good trade practice to yield a weathertight and safe installation.
- .2 Framing shall be installed, glazed and adjusted by experienced personnel employed by bonded installers. All items in the Section shall be set in their correct location and shall be set level, plumb without warp or rack and at proper elevations, and in alignment with other work.
- .3 Secure anchors and joints with provision for expansion and deflection of structure, concealed fixing.
- .4 Ensure that all interfacing of aluminum framing systems and air/vapour barriers is continuous, secure and effective.
- .5 Coordinate fabrication and installation of aluminum glazing system with work of other interfacing sections.
- .6 Dissimilar materials: provide separation of aluminum components from sources of corrosion or electrolytic action contact points.
- .7 Use sufficient corrosion resistant anchorage devices to securely and rigidly fasten glazed units to building, without causing detrimental effects to shape or performance.
- .8 Set glazed units sills level and uniform. Accurately and rigidly fit together all joints. Ensure joints are flush, hairline and weatherproof.
- .9 Caulking between glazed unit sections and materials installed by others: by this

Section, as specified in Section 07 90 00.

- .10 This section shall do all necessary sealing within the glazed unit frames to ensure a weatherproof installation.
- .11 Extend foil faced self-adhering membrane flashing (Section 07 27 13, Clause 2.3) onto the curtainwall framing at the sill and jambs as detailed. Provide sheet aluminum backing to the membrane to prevent wind or pressure differential from blowing-out the membrane seal.
- .12 Extend Dow Corning 123 silicone seal onto curtainwall head framing to allow for movement.

3.3 Curtainwall Installation

- .1 Both curtainwall types shall be outside glazed. Glass on curtainwall shall be secured by toggles on all four sides.
- .2 Water Drainage: Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations. Weep holes shall be located in the horizontal framing members to divert water to the exterior of the building.
- .3 Field Testing: Field tests shall be in conformance with Division 1. Departmental Representative will select wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
- .4 Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 Glass and Glazing

- .1 All aluminum framing systems shall be glazed as specified in Section 08 80 00.
- .2 Glazing as scheduled by type on drawings.
- .3 Safety glass where required by 2015 National Building Code of Canada.

3.6 Field Quality Control

- .1 ref. also Division 1 – Quality Control
- .2 Conduct onsite tests for water infiltration with curtainwall manufacturer's representative present. The Consultant will select areas to be tested.
- .3 The installed performance of the curtain wall system, including the joint to other building components, to conform to:
 - .1 Water penetration: no uncontrolled water leakage through any part of the curtain wall when tested in situ according to ASTM E 1105 at an air pressure difference of 300Pa, when subjected to 5 cycles of 5 min.
- .4 Test curtain wall including perimeter joint and interface with adjacent building construction.
- .5 Test areas as selected by Departmental Representative.

- .6 Correct deficiencies in joints which fail to meet specified requirements, and all joints having similar deficiencies, at no cost to the owner.
- .7 Provide all required air tight chambers as required to complete the field testing.

3.5 Protection and Cleaning

- .1 Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum glazing systems from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.
- .2 Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to the Departmental Representative's acceptance. Remove construction debris from project site and legally dispose of debris.
- .3 At completion of the project, remove protection and clean and polish all surfaces.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 08 11 00 Metal Doors and Frames
- .2 Section 08 44 13 Aluminum Curtainwall

1.2 References

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .2 ANSI (American National Standards Institute) / BHMA (Builder Hardware Manufacturer Association).
 - .1 ANSI/BHMA A156.1, Butts and Hinges.
 - .2 ANSI/BHMA A156.2, Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3, Exit Devices.
 - .4 ANSI/BHMA A156.4, Door Controls (Closers).
 - .5 ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6, Architectural Door Trim.
 - .7 ANSI/BHMA A156.13, Mortise Locks and Latches.
 - .8 ANSI/BHMA A156.16, Auxiliary Hardware.
 - .9 ANSI/BHMA A156.18, Materials and Finishes.
 - .10 UL 305, Panic Hardware
- .3 National Building code of Canada (NBCC), 2015.

1.3 Hardware/Security Coordination

- .1 Prior to preparation and submittal of hardware list, door hardware supplier's hardware consultant shall arrange a coordination meeting with the following attendees:
 - .1 Hardware supplier's hardware consultant
 - .2 Facility's Building Maintenance Manager
 - .3 Departmental Representative
 - .4 General Contractor
- .2 The final door hardware lists shall reflect all decisions made at said coordination meeting.

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Division 1 - Submittal Procedures.

- .2 Hardware List:
 - .1 Submit contract hardware list in accordance with Division - Submittal Procedures.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide operation and maintenance data for door closers, locksets, and panic hardware for incorporation into manual specified in Division 1 - Closeout Submittals.

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 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 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 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Division 1 - Product Requirements.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in locked, clean and dry area.

1.7 Waste Disposal and Management

- .1 Separate and recycle waste materials in accordance with Division 1 - Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.8 Maintenance

- .1 Extra Materials:

- .1 Provide maintenance materials in accordance with Division 1 – Contract Closeout.
- .2 Supply two sets of wrenches for door closers.

1.9 Coordination with Other Sections

- .1 Coordinate certain door hardware items of this Section with interfacing sections including, but not limited to the following:
- .2 Section 08 11 00 Metal Doors and Frames

1.10 Redundant Locksets

- .1 Where existing locksets and other lock-bearing devices are to be removed and disposed of: turn-over to Departmental Representative and obtain receipt. In order to maintain building keying security, no existing locksets are to be removed from building.

PART 2 PRODUCTS

2.1 Hardware Items

- .1 Use one manufacturer's products only for similar items.
- .2 Interior hardware finish generally: BHMA625, satin chrome.
- .3 Exterior hardware finish generally: BHMA630, Satin stainless steel.

2.2 Door Hardware

- .1 Locksets
 - .1 Extra heavy-duty commercial/institutional grade one operational mortise locksets to ANSI/BHMA A156.13 Series 1000, grade one security, UL 10.C.
 - .2 6 pin (or 7) tumbler keying to facility's master system.
 - .3 Trim lever and rose to match existing.
 - .4 ANSI functions as scheduled. (Store room function, lever handle.)
- .2 Butts and hinges
 - .1 To CAN/CGSB-69.18 heavy weight, high frequency, five knuckle, ball bearing (4), NRP at outswing locations.
- .3 Door closers and accessories
 - .1 To CAN/CGSB-69.20 to match Facility's existing closers (verify) model and series. Arms and brackets to suit application.
- .4 Door Stops
 - .1 Floor and wall mounted, cast type, heavy duty, finish to match locksets, complete with appropriate fixings.
- .5 Kickplates

- .1 250 mm high x 25 mm less than door width, 16ga. Anodized aluminum to match other hardware, secure with matching countersunk screws.
- .6 Astragal
 - .1 Overlapping 3 mm steel with vinyl insert, primed for field-painting with doors

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 Use fasteners compatible with materials through which they pass.
- .5 Use tamperproof fasteners in high security hardware.

2.4 Keying Schedule

- .1 Prepare detailed keying schedule in conjunction with Departmental Representative to coordinate with facility's GMK and MK systems.

2.5 Keys

- .1 Use standard construction cylinders for locks for Contractors' use during the construction period, if required.
- .2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instruction, and data sheets.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturer's instructions for proper installation of each hardware component.

3.2 Installation

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer is unacceptable.
- .4 Remove construction cores when directed by Departmental Representative; install permanent cores and check operation of locks.

3.3 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 provide tight fit at contact points with frames.

3.4 Cleaning

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

3.5 Demonstration

- .1 Keying System Setup:
 - .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 existing 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 project's complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.6 Hardware Schedule

- .1 Quantities shown in schedule are for one opening only. Include all hardware for each door listed in door schedule on drawings. See drawings for door layout and arrangement.
- .2 Refer to "hardware heading" column in door schedule on drawings for location of each hardware heading group.

Group No. 1

Hinges, Card Reader / Magnetic Lock, Closer, Weather Stripping, Thermal Break Threshold.

Group No. 2

Hinges(X2), Card Reader / Magnetic Lock, Closer(X2), Weather Stripping(X2), Astragal, Thermal Break Threshold.

Group No. 3

Hinges, Classroom Lockset, Doorstop.

Group No. 4

Hinges, Lockset, Auto Operator, D-Pull, Closer, Weather Stripping by Manufacturer, Thermal Break Threshold.

Group No. 5

Hinges, Privacy Lockset, Auto Operator, Closer.

Group No. 6

Hinges, Lockset, D-Pull, Closer, Weather Stripping by Manufacturer, Thermal Break Threshold.

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

- | | | |
|----|------------------|------------------------|
| .1 | Section 05 50 00 | Metal Fabrications |
| .2 | Section 08 11 00 | Steel Doors and Frames |
| .3 | Section 08 44 00 | Aluminum Curtainwall |
| .4 | Section 08 71 00 | Door Hardware |
| .5 | Division 26 | Electrical |

1.2 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate equipment layout, mounting bolt locations, electric power requirements, lead-in wire, installation details wiring diagrams.

1.3 Maintenance Data and Instructions

- .1 Provide operation and maintenance data in accordance with Division 1.
- .2 Conduct comprehensive demonstration for accommodation of maintenance staff on operation and care of systems in accordance with Division 1.

1.4 Power Supply

- .1 Power Supply: 120 volt, 60Hz, single phase. Verify.

1.5 Quality Assurance

- .1 Provide automatic entrance systems that comply with applicable requirements of Low-Energy Automatic Door Standard, ANSI A156.19.
- .2 Provide powered door operators complying with UL325, Electrical Door, Drapery, Gate, Louver and Window Operators and Systems.
- .3 Manufacturer's Qualifications: Provide units produced by a firm with not less than five years successful experience in the fabrication of automatic doors of the type required for this project.
- .4 Installer's Qualifications: Engage installers who are authorized representatives of the automatic entrance door manufacturer for both the installation and maintenance of the type units required for this project.

1.6 Coordination with Door Hardware

- .1 Coordinate all work of this Section with that of Section 08 71 00 – Door Hardware, to ensure electrical and operational compatibility with such components as cylinders, electric strikes, lock and latch sets.

PART 2 PRODUCTS

2.1 Description of Systems

- .1 New automatic door operators for installation in aluminum entrance and vestibule doors and frames:
 - .1 New automatic operator: surface mounted on door heads.
 - .2 Wiring between operator and control switches shall be routed through

aluminum frames, walls and ceilings.

- .3 System must allow for normal manual operation of doors at all times.
- .4 System must be lockable.
- .5 Run underground wiring between operators and bollards in waterproof, corrosion resistant plastic conduit. Refer to Division 26.

2.2 System Operation

- .1 Entrances:
 - .1 Activation of Push button switching either from exterior or interior shall open the active door leaf.
 - .2 Operator on outer door shall have key activated on-off switch for deactivation and security after hours.
 - .3 Automatic door operation shall be coordinated in tandem between outer entrance door and inner vestibule door.
- .2 Interior Doors:
 - .1 Activation of push button switching from either side of door shall open the active leaf.

2.3 System Equipment

- .1 Automatic door operating mechanism shall be a low-energy, self-contained, electromechanical design. The operator shall be powered open with a DC motor working through six reduction gears. Closing shall be by spring force. The motor is to be off when the door is in the closing mode. The door may be manually operated with power on or off without damage to the operator.
- .2 Motor shall be sized to accommodate size and material of doors.
- .3 The control shall be furnished with a selection switch that provides for two methods of actuating the automatic door. The selection switch will enable the building users to select the desired operation and adapt to changing conditions.
- .4 The operator shall include the following variable adjustments to enable it to comply with Standard ANSI A156.19:
 - .1 Opening speed: 4 to 6 seconds
 - .2 Closing speed: 4 to 6 seconds
 - .3 Time delay before closing: 2 to 30 seconds (ANSI requirement is 5 second minimum time delay).
- .5 Opening and closing force, measured 50.8mm out from the lock stile of the door, not to exceed 67N of force to stop the door when operating in either direction.
- .6 The operator shall include "time out" feature. This feature will turn off the opening force when the door is stopped for one second. The door then begins to close. The operator immediately resets and will accept another opening signal.
- .7 The operator shall be mounted and concealed in an extruded aluminum cover not less than 3mm thickness in clear anodize. Cover shall run width of door.
- .8 Interior and exterior push button switches mounted where shown. Exterior shall be lockable and tamper-proof. Handicapped marking not required. Coordinate supply of cylinders with Section 08 71 00.
- .9 Division 26 shall furnish and install 120 VAC, 60 cycle, 1 phase, 15 amp service to the operator. Two low-voltage wires shall be furnished to connect push-plate

switch to the operator.

PART 3 EXECUTION

3.1 Inspection

- .1 Assure that frame openings correspond to dimensions of frames furnished. Floor conditions must be suitable for safety and performance. Check that surfaces to contact frames are free of debris. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 Installation

- .1 Install system to equipment manufacturer's instructions.
- .2 Locate equipment where indicated or as directed by Consultant.
- .3 Install, plumb, level true-to-line and rigidly secure in openings. After applying operator and hardware, adjust to achieve smooth and quiet operation. Install in accordance with approved shop drawings.
- .4 Test and adjust complete system for proper function and leave in perfect working order.
- .5 Protect doors, frames and glazing from damage.
- .6 Coordinate work of this Section with that of electrical, security and metal fabrication trades.

3.3 Adjustment and Cleaning

- .1 Remove dirt and excess sealants or glazing compound from exposed surfaces.
- .2 Adjust moving parts for smooth operation.
- .3 Remove debris from project site.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 06 20 00 Finish Carpentry and Millwork
- .2 Section 08 11 00 Steel Doors and Frames
- .3 Section 08 44 00 Aluminum Curtainwall

1.2 References

- .1 The current version of the following publications and standards:
 - .1 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - .2 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.
 - .3 CAN/CGSB-12.3, Float Glass.
 - .4 CAN/CGSB-12.4, Heat Absorbing Glass.
 - .5 CAN/CGSB-12.5, Mirrors, Silvered.
 - .6 CAN/CGSB-12.8, Insulating Glass Units.
 - .7 Laminators Safety Glass Association (LSGA) Standards Manual.
 - .8 Glass Association of North America (GANA): Glazing Manual, Engineering Standards, Manual and Laminated Glazing Reference Manual.
- .2 Model National Energy Code for Buildings (NECB).
 - .1 NECB 2011.
- .3 National Building Code of Canada (NBCC), 2010.

1.3 Quality Assurance

- .1 Professional Engineering:
 - .1 This section shall be responsible for providing engineering design necessary to supply glass thicknesses required to safely span openings indicated.
 - .2 A professional Engineer (Specialty Engineer), registered in British Columbia shall prepare, seal and sign all shop drawings and perform field reviews.
- .2 Standards:
 - .1 Comply with recommendations in the following publications, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section:
 - .1 GANA Glazing Manual.
 - .2 GANA Engineering Standards Manual.
 - .3 GANA Laminated Glazing Reference Manual.
 - .2 Exterior fenestration assemblies shall comply with the energy conservation requirements of NECB 2011, prescriptive Path.
- .3 Manufacturing:
 - .1 Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single

manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002, latest version.

- .4 Installation:
 - .1 Provide the work of this section executed by specialist Contractor who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this Section.
- .5 Conduct quality control in accordance with Division 1.

1.4 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Product data sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section
- .3 Shop drawings:
 - .1 Submit signed and sealed engineered shop drawings.
 - .2 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
- .4 Samples:
 - .1 Submit 305 mm (\pm) square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm long samples of each colour required, except black, for each type of sealant or gasket exposed to view.
 - .1 Submit 3 control samples for each glass type showing maximum range of visible difference between units for the project, if requested.
- .5 Submit test and evaluation reports:
 - .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- .6 Manufacturer Reports:
 - .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.

- .7 Submit sample glazing warranty.
- .8 If requested, submit copy of letter from IGMAC or a test report prepared by independent testing company confirming insulating glass units of the types required have been successfully tested in accordance with CAN/CGSB 12.8-97 and will withstand design loads specified herein.
- .9 Closeout Submittals:
 - .1 Submit closeout submittals in accordance with Division 1.
 - .2 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 Performance / Design Criteria

- .1 Glass strength:
 - .1 Provide glass products in the thickness and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on project loads and in-service conditions.
 - .1 Analysis shall comply with CAN/CGSB 12.20, latest edition.
 - .2 Minimum thickness of annealed or heat-treated glass products shall be selected so that worst case probability of failure does not exceed the following:
 - .1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.
 - .2 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind and/or snow.
 - .3 Maximum lateral deflection sealed double vision glass units: for insulating glass units supported on four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 19 mm maximum.
- .2 Safety and Building Code:
 - .1 At locations subjected to human impact loads and where required by NBCC, 2010: provide safety glass in accordance with the latest revisions to CAN/CGSB 12.1 and 12.20.
 - .2 Glass thicknesses and glass types specified, indicated, or scheduled are minimums required. Glazing "Specialty Engineer" shall modify as required to satisfy design and building code requirements, and any such modifications shall be clearly indicated on shop drawings.
- .3 Thermal and Optical performance:
 - .1 Provide glass products with performance properties published by glass manufacturer. Performance properties shall be manufacturer's published data as determined according to the following procedures:
 - .1 Centre of glass U-Value: National Fenestration Rating Council (NFRC) 100 methodology using LBNL WINDOW 5.2 computer program.
 - .2 Centre of glass solar heat gain coefficient: NFRC 200 methodology using LBNL-35298 WINDOW 5.2 computer program.
 - .3 Solar optical properties: NFRC 300.
- .4 Sealed Double Vision Glass Units:

- .1 IGMAC Certified, hermetically sealed, to CAN/CGSB 12.8 (latest) minimum 12 mm air space, 90% argon/10% air filled, double sealed edges (primary: polyisobutylene, secondary: polysulphide), desiccant filled stainless steel spacer bar.
 - .1 There shall be no voids or skips in the primary seal or the secondary seal.
- .2 Performance requirements: for glass units; based on above description:
 - .1 Visible light transmittance (VLT): within 68 – 70%.
 - .2 Winter night-time U-value: 0.24.
 - .3 Low 'E' soft coating (equal to Cardinal "LoE-366") on No. 2 surface.
 - .4 Solar heat gain coefficient (SHGC): 0.40.
 - .5 Exterior pane: uncoated green tinted glass with average daylight transmittance of 75 percent.

1.6 Storage and Handling

- .1 Protect glass from edge damage during handling. For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.
- .2 Storage and protection: Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 Site Conditions

- .1 Ambient Conditions: do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.
- .2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4°C.

PART 2 PRODUCTS

2.1 Glass Type Descriptions

- .1 Type "1"
Float glass – Clear glazing quality to CAN/CGSB-12.3 (latest). Of thicknesses as determined by "specialty engineer" to meet loading and building code requirements.
- .2 Type "2" (Safety Glass)
 - .1 Single glazed, clear (or tinted) tempered safety glass, (Engineer-verified thicknesses for spans indicated) transparent tempered float glass to CAN2-12.1 (latest), Type 2, Class B.
 - .2 Tempering shall be performed using convection type furnace.
 - .3 Tempered and heat strengthened glass shall be treated prior to applying reflective or paint coatings.
 - .4 Tempering shall be performed using the horizontal tong-free method.
 - .5 Orient tempered glass in manner to produce consistent appearance.
- .3 Type "3" (Sealed Double Vision Glass)

- .1 Sealed double vision glazing, pane thicknesses as determined by "Specialty Engineer" to NBC Code requirements. (Use Type "2" glass where required by building code). Green tinted (to match approved samples) outboard lite, clear inboard lite with Low "E" coating on No. 2 surface.
- .4 Type "4" (Sealed Double Acoustical Glass)
 - .1 Sealed double vision glazing, pane thicknesses as determined by Specialty Engineer to NBC Code requirements. (Use Type "2" glass where required by code). 6 mm green tinted (to match approved samples) outboard lite, laminated inboard lite from two 3 mm clear float glass panes with 0.030 PVB interlayer.
- .5 Type "5" (Sealed Double Security Glass)
 - .1 Sealed double vision glazing, outboard pane: two laminated 3 mm sheets of clear tempered safety glass with a minimum 0.76 mm thick fully bonded, high impact, UV resistant clear Polyvinyl Butyral (PVB) interlayer. Inboard pane: 6 mm clear tempered glass with low "E" coating on No. 2 surface. Refer to Section 13 22 00 – Prefabricated Booths and 08 43 00 – Aluminum Store Front.
- .6 Type "6" (Wired Safety Glass)
 - .1 Georgian polished wire glass, to CAN/CGSB 12.1-M90, Type 1, Style 3, 6 mm thick minimum, clear.
- .7 Type "7" (Plastic Glazing)
 - .1 Plastic glazing, to CAN2/CGSB-12.12-M79, Clear, acrylic sheet, 3.2 mm thick, light transmission of 80% minimum.
- .8 Type "8" (Polycarbonate Glazing)
 - .1 10 mm thick polycarbonate sheet with monolithic abrasion resistant coating both sides conforming to ASTM F1233 Class II and 1915 Grade 4, HP white level I-TP-0500.02 equal to Lexan "MR10".
- .9 Mirrors (Un-framed)
 - .1 Type 1, quality q1, class 2 to ASTM C1036-06, fully tempered glass, Kind FT to ASTM C1048-04 coated, tinted grey, 6 mm thick. Exposed edges shall be chamfered, ground and polished.
 - .2 Reflective coating: Pyrolytic coating meeting the requirements of ASTM C1376-03.
 - .3 Glass shall transmit not less than 5% or more than 11% of total incident visible light and shall reflect from the front surface of the coating not less than 45% of the total incident visible light.

2.2 Glazing Materials

- .1 Glazing materials: general: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - .1 Performed, EPDM, silicone compatible, to ASTM C864-05.
- .3 Setting blocks: Silicone material with Shore, Type A durometer hardness of 85, plus or minus 5.
- .4 Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- .5 Edge blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
- .6 Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

2.3 Acrylic Panels

- .1 Where scheduled as "GL-1" acrylic divider panels associated with millwork, Section 06 20 00.
- .2 Panel material shall be composed of optical grade engineered resin incorporating 30% recycled content, 12 mm thick with standard saw-cut square edge finishing.
- .3 Selected product: "Chroma" Style 3 Form, with renewable matte front finish and matte back. Style "Pewter".
- .4 Install, as detailed, in aluminum glazing channels.

PART 3 EXECUTION

3.1 Examination

- .1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - .2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.
 - .3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.
 - .4 Presence and functioning of weep systems.
 - .5 Minimum required face and edge clearances.
 - .6 Effective sealing between joints of glass-framing members.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
- .3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's instructions. Ensure surfaces are free of moisture and frost.

3.3 Glazing - General

- .1 Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .3 Protect glass edges from damage during handling and installation. Remove damaged glass from project site and legally dispose of off project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determine by preconstruction testing.
- .6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in think course of compatible sealant suitable for heel bead.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm.
 - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - .2 Provide 3.2 mm minimum bite of spacers on glass and use thickness equal to sealant width.
- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.
- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- .12 Hollow Metal Doors and Frames: Specified under work of Section 08 11 00. Install glazing as scheduled. Fixed stop bedding, glazing tape, removable stops, glazing tape.

3.4 Gasket Glazing (Dry)

- .1 Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

- .2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- .3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .5 Install gaskets so they protrude past face of glazing stops.

3.5 Sealant Glazing (Wet)

- .1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 Mirror Installation

- .1 Install mirrors where indicated using concealed fixing ("Vancouver Clips") and adhesive applied in maximum 300 x 300 mm grid for seismic restraint

3.7 Protection

- .1 Provide safety markings to installed glass by attaching streamers or tape to face of sash. Do not apply tape directly to the glass. Do not mark the glass with paint or any other substance that is hard to remove or could leave permanent stains.
- .2 Take all precautions necessary to protect stored glass and installed glass from lime mortar, water run-off from concrete or copper, weld spatter, acids, roofing tar, solvents, abrasive cleaners, careless handling of construction machinery and equipment, and any other activities that could permanently damage the glass.
- .3 Install protective cover to glass where there is a high risk of damage. Use plywood, heavy kraft paper, or non-staining transparent plastic sheet. Do not let protective materials contact surface of glass.
- .4 Do not rely on use of adhesive plastic films to protect installed glass. When plastic sheeting is used, it must be transparent, suspended away from the surface of the glass, and be provided with adequate ventilation holes to prevent heat build-up.

3.8 Finishing

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.
- .2 Final cleaning of glass in accordance with Section 01 74 00.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

1. Interior steel studs, metal detailed framing, metal furring channels, floor and ceiling track and associated accessories, including design and engineering.
2. Installation of hollow metal door frames in steel stud partitions.

1.2 Related Work

- | | | | |
|----|---------|----------|-------------------------------|
| 1. | Section | 05 41 00 | Structural Metal Stud Framing |
| 2. | Section | 06 10 00 | Rough Carpentry |
| 3. | Section | 08 11 00 | Metal Doors and Frames |
| 4. | Section | 09 29 00 | Gypsum Board |
| 5. | Section | 09 53 00 | Acoustical Ceiling Suspension |

1.3 Standard Specifications

1. Unless otherwise shown or specified, materials and workmanship shall meet the standards detailed in the Specification Standards Manual of the British Columbia Wall and Ceiling Industry.
2. Where standards are outlined herein, it will not preclude the use of other standards included in the Specification Standards Manual where such standards are approved in writing by the Consultant.
3. Reference in these project specifications to Section numbers, Parts, and Item numbers, means those within Section 9.7 of the Specification Standards Manual.

1.4 Submittals

1. All submittals shall be in accordance with Section 01 33 00 – Submittals.

PART 2 PRODUCTS

2.1 Interior Steel Studs

1. As specified in BCWC Section 9.7, Part 2, Items 1 & 2 to ASTM C645-76.
2. Galvanized steel studs, width and gauge as per Specialty Engineer.
3. Use min. 20 gauge galvanized steel studs (doubled) at door jambs.
4. Supply special extended leg head track on walls subjected to deflection of the structure above.
5. Bottom track as per Specialty Engineer.
6. (Nested) top track as per Specialty Engineer.

2.2 Furring Channels

1. As specified in BCWC Section 9.7, Part 2, Item 3.
2. Min. 25 ga. galvanized steel hat shaped channels with knurled face 22 mm thick.

2.3 Ceiling Suspension Membranes

1. As specified in BCWC Section 9.7, Part 2, Item 4.
2. Member size to suit spans and loads as per BCWC tables and NBCC 2010.

PART 3 EXECUTION

3.1 Installation Interior Steel Studs

1. Install steel and stud partitions in accordance with BCWC Section 9.7, Part 3, Item 2. Studs 400 mm o.c. maximum.
2. Use doubled 20 Ga. thick studs each side of door frames.
3. Erect new hollow metal door frames in steel stud partitions.
4. Use double walls where required to accommodate piping, ducts, exist. wall thicknesses, etc.
5. Install access panels for other trades where directed.
6. Note miscellaneous interior framing.
7. Use extended leg ceiling track in areas where deflection of structure will be present.

3.2 Installation Vertical & Horizontal Furring

1. Install vertical and horizontal furring in accordance with BCWC Section 9.7, Part 3, Item 4 spaced 400 mm o.c. maximum.

3.3 Installation Ceiling Suspension System

1. .1 Install ceiling suspension system in accordance with BCWC Section 9.2, Part 3, Item 5.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- | | | |
|----|------------------|-------------------------------|
| .1 | Section 05 41 00 | Structural Metal Stud Framing |
| .2 | Section 07 21 00 | Insulation |
| .3 | Section 07 92 00 | Joint Sealants |
| .4 | Section 09 22 00 | Non-Structural Metal Framing |
| .5 | Section 09 30 13 | Ceramic Tile |

1.2 Reference Standards

- .1 ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
- .2 ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .3 ASTM C 630 Standard Specification for Water-Resistant Gypsum Backing Board.
- .4 ASTM C 840 Standard Specification for Application and Finishing of Gypsum Board.
- .5 ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .6 ASTM C 1396 Standard Specification for Gypsum Board.
- .7 ASTM C 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- .8 ASTM C 84 Standard Test Methods for Surface Burning Characteristics of Building Materials.
- .9 Unless otherwise shown or specified, materials and workmanship shall meet the standards detailed in the Specification Standards Manual of the British Columbia Wall and Ceiling Industry and printed matter issued by the product manufacturers.
- .10 Where standards are outlined herein it will not preclude the use of other standards included in the Specification Standards Manual where such standards are approved in writing by the Departmental Representative.
- .11 Reference in these project specifications to Section numbers, Parts, and Item numbers means those within Section 9.6 of the Specification Standards Manual.
- .12 National Building Code of Canada (NBCC), 2015, and BC Building Code (BCBC) 2018.

1.3 Quality Assurance

- .1 Contractor executing the work of this section shall have a minimum of 10 years continuous experience in successful installation of work of type and quality indicated and specified.
- .2 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

- .3 Provide gypsum board materials that comply with the following limits for surface burning characteristics when tested as per ASTM E84:
 - 1. Flame spread: 25, maximum.

1.4 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Product Data Sheets:
 - 1. Submit manufacturer's product data sheets for products proposed for use in the work of this section.
- .3 Fire-Rated Assembly Listings:
 - 1. Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.

1.5 Environmental Requirements

- .1 Environmental requirements, general: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.
- .2 Cold Weather Protection: When ambient outdoor temperatures are below 12°C maintain continuous, uniform comfortable building working temperatures of not less than 12°C for a minimum period of 48 hours before, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- .3 Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
- .4 Protection: Provide adequate protection of materials and work of this section from damage by weather and other causes. Protect work of other trades from damage resulting from work of this section. Make good such damage at no additional cost to the Departmental Representative.

1.6 Delivery, Storage and Handling

- .1 Store materials in protected dry areas. Store gypsum board flat in piles with edges protected.
- .2 Ensure that finish metal members are not bent, dented, or otherwise deformed.
- .3 Deliver products supplied under the work of this section only to those who are responsible for installation, to the place they direct, and to meet installation schedules.
- .4 Package fire rated materials with labels attached.

PART 2 PRODUCTS

2.1 Gypsum Board (Interior)

- .1 Standard gypsum board: paper faced gypsum core panel solid set core enclosed in paper, 13 mm thick unless otherwise indicated, 1220 mm wide x maximum practical length, ends square cut, tapered edges, to ASTM C1396/C1396M-06a. Mold and moisture resistant.

2.2 Paperless Gypsum Board (Interior)

- .1 For use as tile backerboard, wall and ceiling board in moist areas and where otherwise scheduled.
- .2 Gypsum wallboard faced with FRP glass mats in lieu of paper producing moisture and mold resistance when tested by ASTM C1178/C1178M-06 procedures. Use fire-resistant (Type 'X'), to ASTM C1658/C1658M-06, where indicated and required for fire resistance rating.
- .3 Physical properties of board:
 - .1 Thickness: 15.9 mm.
 - .2 Width: 1219 mm.
 - .3 Length: longest practical length available.
 - .4 Weight: 2020 pounds per M square foot.
 - .5 Edges: Tapered.
 - .6 Surfacing: Coated glass mat on face, back, and long edges.
 - .7 Flexural Strength, Parallel (ASTM C473, ASTM C1177): Not less than 80 pounds.
 - .8 Flexural Strength, Perpendicular (ASTM C473, ASTM C1177): Not less than 100 pounds.
 - .9 R-Value (ASTM C 518): Not less than 0.56.
 - .10 Nail Pull Resistance (ASTM C473, ASTM C1177): Not less than 80 pounds.
 - .11 Hardness, Core, Edges, and Ends (ASTM C473, ASTM C1396): Not less than 15.
 - .12 Water Absorption (ASTM C473, ASTM C630, and ASTM C1396): Less than 5% of weight.

2.3 Exterior Sheathing Board

- .1 Exterior grade fiberglass mat faced on front and back sides and long edges, silicone-treated water-resistant gypsum core, to ASTM C1177/C1177M-06 Type 'X', fire rated where indicated.
- .2 Exposure to weather: Comply with manufacturer's printed instructions. Provide protection prior to exposure for periods greater than manufacturer's recommendations and warranty.
- .3 Acceptable products:
 - .1 CertainTeed 'GlasRoc Sheathing'.

- .2 CGC 'Securock Glass-Mat Sheathing'.
- .3 Georgia-Pacific 'Dens-Glass Gold'.

2.4 Metal Furring

- .1 Metal furring runners, hangers, tie wires, inserts, anchors: to CSA A82.30-M1980, galvanized.
- .2 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .3 Resilient clips drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

2.5 Adhesives

- .1 Laminating compound: to CSA A82.31.2.6 Accessories
- .1 Casing Beads: 0.5 mm base thickness commercial grade sheet steel with G90 zinc finish to ASTM A525-80A, perforated flanges; one piece length per location.
- .2 Acoustic Sealant: to CGSB 19-GP-21M. Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Panel for Joint Sealants.
- .3 Joint Compound: to CSA A.82-31-M1980, asbestos free.
- .4 Corner Beads: 32 x 32 mm, 6063-T5 aluminum alloy.

2.6 Aluminum Drywall Reveal Reglet (RG-1).

Installed Aluminum shall be extruded alloy 6063 T5, with chemical conversion coating, clear anodized or other specified finish.

2.7 Fastening and Finishing

- .1 Nails, screws, tape, joint compound, and taping compound as specified in Section 9.5, Part 2, Item 2 of the Specification Standards Manual and the board manufacturer's printed instructions.
- .2 Corner beads, casing beads as specified in Section 9.6, Part 2, Item 3 of the Specification Standards Manual and the board manufacturer's printed instructions.

2.8 Fastening

- .1 Nails, screws, and staples: to ASTM C380.

PART 3 EXECUTION

3.1 Interior Gypsum Wallboard Application

- .1 Apply drywall in accordance with ASTM C 840, Section 9.6, Part 3, Item 6 of the Specification Standards Manual and printed instructions issued by the board manufacturer.
- .2 Gypsum wallboard shall be attached to metal studs, furring or ceiling channels by screw application.
- .3 Gypsum wallboard shall be attached to concrete or masonry by adhesive.
- .4 Use fire resistant gypsum wallboard (Type X) for fire rated walls and ceilings applied in accordance with U.L.C. design for fire rating required.
- .5 Apply paperless drywall to damp and wet areas, as tile backerboard (except at shower compartment), and where noted and scheduled.
- .6 Use Abuse-Resistant Board (in conjunction with metal mesh by Section 09 22 00).

3.2 Corner Beads & Casing Beads

- .1 Install corner beads and casing beads in accordance with Section 9.6, Part 3, Item 11 of the Specification Standards Manual.

3.3 Finishing and Joint Treatment

- .1 Finish field joints, internal angles, screw heads, beads and trim in accordance with Section 9.6, Part 3, Item 4.1 of the Specification Standards Manual for a Level 5 finish. Level 4 finish for surfaces not exposed to view).

3.4 Sound Retardant Application

- .1 Where scheduled and detailed:
 - .1 Install foam gasket tape in joint between ceiling track and ceiling soffit.
 - .2 Install sound insulation blankets between studs full height of partition, tightly fitted to studs, electrical boxes, ducts and other penetrations.
 - .3 Install a 10 mm continuous bead of acoustical sealant between joint of gypsum wallboard and floors or abutting vertical surfaces.

3.5 Grouting of Metal Door Frames

- .1 During drywall application, grout metal door frames solid with hardwall plaster grout.
- .2 Mix grout in proportions of 1 part hardwall plaster to 2-1/2 parts by weight of sand.

3.6 Patching and Pointing

- .1 Point and patch drywall and leave work complete and ready for painting.

3.7 Accessories

- .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 o.c. using contact adhesive for full length.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

3.8 Trim

- .1 Minimize joints; use corner pieces and splicers.

3.9 Clean-up

- .1 Clean-up rubbish daily and take care to avoid defacing adjoining work.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 06 20 00 Finish Carpentry and Millwork
- .2 Section 07 92 00 Joint Sealants
- .3 Section 10 28 00 Washroom Accessories

1.2 Reference Standards

- .1 ANSI A108/A136.1-2005 – Specifications for the Installation of Ceramic Tile.
 - .1 ANSI A108-17 – Installation of Crack Isolation Membranes for Thin-Set Tile and Dimension Stone.
 - .2 ANSI A118.6 – Specifications for Ceramic Tile Grouts.
 - .3 ANSI A118.12 – Crack Isolation Membranes.
- .2 ANSI A137.1 – Standard Specifications for Ceramic Tile.
- .3 ASTM F-1896 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs.
- .4 CAN/CGSB-75.1-M88
- .5 Terrazzo, Tile and Marble Association of Canada (TTMAC), latest edition, Specification Guide 09300, Tile and Terrazzo Installation Manual.

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Samples
 - .1 Submit duplicate 300 x 600 mm sample panels of each colour, texture, size and pattern of tile in accordance with Section 01 33 00.
 - .2 Adhere tile samples to 12 mm thick plywood and grout joints to represent project installation.

1.4 Maintenance Materials

- .1 Provide minimum 5% or minimum one carton of each type and colour of tile required for project for maintenance use. Store where directed.
- .2 Maintenance material to be of same production run as installed material.

1.5 Environmental Conditions

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 10 degrees C for twenty-four (24) hours before, during, and twenty-four (24) hours after installation.

PART 2 PRODUCTS

2.1 General

- .1 Refer to the Colour and Finishes Schedule, Appendix A.
- .2 The Finish Schedule lists specific manufacturers, patterns and colours upon which colour schemes for the Project have been based. The Departmental

Representative will consider substitute Products that meet or exceed the properties of the specified Product and that are similar in material, construction, thickness, colour, texture, and overall quality, provided that proposals are submitted to the Departmental Representative complete with samples, colours and whatever other data the Departmental Representative may require to evaluate the proposed Product. If the Departmental Representative approves the proposed Product, the Contractor will have the option of providing Product listed in the Finish Schedule or an approved alternative.

2.2 Wall Tile

- .1 Refer to Appendix A.

2.3 Metal Edge Trim and Control Joint

- .1 Edge trim
Acceptable product example: Schluter "Schiene", satin anodized aluminum finish.
- .2 Control joint
Acceptable product example: "Schluter "Dilex AKWS 100", colour: grey.
- .3 Misc. trim
Acceptable product example: "Schluter of model appropriate to application.

2.4 Mortar and Adhesive Materials

- .1 Cement: white to CSA-A5, type 10
- .2 Sand: to ASTM C144, passing 16 mesh.
- .3 Hydrated Lime: to ASTM C207, Type N.
- .4 Latex: formulated for use in Portland cement mortar and thin set bond coat.
- .5 Water: potable and free of minerals which may discolour mortar
- .6 Colour Pigment: non-fading mineral oxides, unaffected by lime or cement and which will not stain tile.
- .7 Organic Adhesive: to C.G.S.B. 71-GP-22M.
- .8 Thin set bond cast.
- .9 Dry set mortar: to ANSI A118.1.

2.5 Grout

- .1 Shall exceed ANSI A118.8, modified epoxy emulsion mortar and grout.
- .2 Accepted product: MAPEI, Colours as selected by Departmental Representative. (or scheduled) (premium grades) (Refer to Interior Finish Material and Colour Schedule).

2.6 Mortar and Adhesive Mixes

- .1 Slurry coat: cement and water mixed to creamy paste. Latex additive may be included.
- .2 Mortar bed for floors: one (1) part cement, four (4) parts sand, one (1) part water. Water volume may be adjusted depending on water content of sand. Latex additive shall be included.

- .3 Leveling coat: one (1) part cement, four (4) parts sand, minimum 1/10 part latex additive, one (1) part water including latex additive.
- .4 Bond or setting coat: one (1) part cement, 1/3 part lime, one (1) part water, latex additive.
- .5 Measure mortar ingredients by volume.
- .6 Dry set Mortar: mix to manufacturer's instructions.
- .7 Organic adhesives: pre-mixed.

2.7 Uncoupling Membrane

- .1 3 mm thick, orange, high-density polyethylene membrane with a grid structure of 12 mm x 12 mm square cavities, each cut back in a dovetail configuration, and a polypropylene anchoring fleece laminated to its underside. Must conform to definition for uncoupling membranes in the Tile Council of North America Handbook for Ceramic Tile Installation; and meet or exceed the requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10". Must be listed by cUPC®, and evaluated by ICC-ES (see Report No. EST-2467). Adhesive as recommended by the manufacturer.
- .2 Employ in shower rooms, wet areas or floor substrates where required as the result of testing. (Clause 3.1.2).
- .3 An example of the accepted product is Schluter® "Ditra". Other products having the same characteristics will not be excluded.

2.8 Waterproofing Membrane

- .1 Where scheduled and required in shower rooms and other wet areas.
- .2 0.2 mm thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides, which meets or exceeds the requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10," and is listed by cUPC®, and is evaluated by ICC-ES (see Report No. ESR-2467). Provide adhesive as recommended by manufacturer.
- .3 An example of the accepted product is Schluter® "Kerdi" membrane. Other products having the same characteristics will not be excluded.

2.9 Crack Isolation Membrane (Where Required)

- .1 Underlayment membrane employed to dissipate effects of minor cracks in concrete slab substrates.
- .2 An example of the accepted product is "Flexolastic 1000" by Flex Tile. Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 Preparation and Testing

- .1 Perform vapour emission tests on concrete floors regardless of the age or grade level. Verify concrete substrate is dry in accordance with the Industry Standards

Slab Moisture Test Method (Calcium Chloride Method), in strict accordance with instructions.

- .2 Perform moisture conditions test in each major area. A minimum of one test per 93m² per 24 hours via the Calcium Chloride Test Method (ASTMF-1896). If sub-floor moisture exceeds the allowable maximum for installing ceramic tile (thin-set), install underlayment of uncoupling membrane.
- .3 If vapour emission of concrete slab is within acceptable limits, install crack isolation membrane only (where required).

3.2 **Workmanship**

- .1 Apply tile or backing coats to clean and sound surfaces.
- .2 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even.
- .3 Maximum surface tolerance 1:800 for walls, and floors.
- .4 Make joints between floor and wall tile uniform and approximately 1.5mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation.
- .5 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .6 Sound tiles after setting and replace hollow sounding units to obtain full bond.
- .7 Make internal angles square, external angle bullnosed.
- .8 Use bullnose edged tiles at termination of wall tile panels, except where panel butts projecting surface or differing plane.
- .9 Install divider strips at junction of tile flooring and dissimilar materials.
- .10 Allow minimum twenty-four (24) hours after installation of tiles, before grouting.
- .11 Clean installed tile surfaces after installation and curing of grout.

3.3 **Wall Tile**

- .1 Install tiles on wall board walls in accordance with TTMAC detail 304W, wall tile installed over wall board on interior dry surfaces only using thin set bond coat and dry curing wall grout.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Division 1
- .2 Section 09 53 00 Acoustical Ceiling Suspension
- .3 Appendix A Finishes and Colours Schedule

1.2 References

- .1 American Society for Testing and Materials (ASTM), current standards
 - .1 ASTM E1264-08e1, Classification for Acoustical Ceiling Products.
- .2 Underwriters Laboratories of Canada (ULC), current standards
 - .1 CAN/ULC-S102-88(R2000), Surface Burning Characteristics of Building Materials.

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Submit duplicate full size samples of each type of ceiling unit.
- .3 Submit shop drawings showing layout and attachment details for sound absorptive wall & ceiling panels which are exposed to view.

1.4 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Division 1 – Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

1.5 Environmental Requirements

- .1 Permit wet work to dry before commencement of installation.
- .2 Maintain uniform minimum temperature of 15 deg C and humidity of 20 - 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

1.6 Extra Materials

- .1 Provide extra materials of acoustic units in accordance with Division 1 – Closeout Submittals.
- .2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.
- .3 Extra materials to be from same production run as installed materials.

- .4 Clearly identify each type of acoustic unit, including colour and texture.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.
- .6 Store where directed by Departmental Representative.

PART 2 PRODUCTS

2.1 Type 'ACT-1' Acoustic Ceiling Tiles

- .1 New beveled tegular-edged (for Imperial grid) wet-formed mineral fibre acoustical tile units, non-directional, white, and possessing the following characteristics:
 - .1 CAC Rating: 35
 - .2 Light Reflectance: 0.87
 - .3 ASTM E1264 Classification: Type IV, Form 2, Pattern E, Fire Class A.
 - .4 30-year system performance guarantee against visible sag.
 - .5 Flame Spread: 25 or under (UL labelled) per ASTM E84, smoke developed: 50.
 - .6 NRC Rating: 0.80
 - .7 Size: 610 mm x 1219 mm x 25 mm (for imperial grid).
 - .8 Recycled content: up to 62%.
- .2 For example of an approved product, refer to Appendix A.

2.2 Type 'ACT-2' Acoustic Ceiling Tile

- .1 New square-edged (for imperial grid) lay-in wet-formed mineral fibre acoustical units, non-directional, white, with acoustically transparent membrane to produce a scrubbable and water repellent surface, and possessing the following characteristics:
 - .1 CAC Rating: 35
 - .2 Light Reflectance: 0.86
 - .3 ASTM E1264 Classification: Type IV, Form 2, Pattern E, Fire Class A
 - .4 Flame Spread: 25 or under (UL labelled) per ASTM E84, smoke developed: 50
 - .5 NRC Rating: 0.70
 - .6 Size: 610 mm x 1219 mm x 19 mm (for imperial grid).
 - .7 30 year limited system warranty against visible sag, mold/mildew and bacterial growth.
 - .8 Recycled Content: 65% pre-consumer, 15% post-consumer.
- .2 For example of an approved product, refer to Appendix A.

PART 3 EXECUTION

3.1 Examination

- .1 Do not install t-bar acoustical tiles until work above ceiling has been inspected by Departmental Representative.

3.2 Acoustical T-Bar Tile Installation

- .1 As scheduled, install new lay-in panels in new 24mm t-bar ceiling suspension system.
- .2 Commence installation when all work in ceiling space has been completed, inspected and tested.
- .3 Coordinate with mechanical and electrical trades for cut-outs, fixture and equipment penetrations, etc.

3.3 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.

END OF
SECTION

PART 1 GENERAL

1.1 Related Word

- .1 Section 09 84 00 Acoustical Wall & Ceiling Panels
- .2 Division 23 Trim to Recessed Mechanical Fixtures
- .3 Division 26 Trim for Recessed Light Fixtures

1.2 Reference Standards

- .1 American Society for Testing and Materials (ASTM International), current standards.
 - .1 ASTM C635-00, Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .2 ASTM C636-96, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .3 ASTM E580 1984, "Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint".

1.3 Design Criteria

- .1 Maximum deflection" 1/360th of span to ASTM C635 deflection test.
- .2 Hanger inserts in structure shall be capable of developing full strength of hangers they support.
- .3 Design suspension system to conform to seismic restraint requirements of NBCC 2015, BCBC 2018, and as specified herein. Include Professional Engineering fees in Contract Price.
- .4 Submit Human Resource Development Canada Fire Protection Engineering Services Schedules B-1, B-2 and C-B sealed by a qualified professional Engineer registered in the Province of British Columbia.

1.4 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Division 1 – Waste Management and Disposal.
- .2 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Materials

- .1 Heavy duty system to ASTM C635, current edition.

- .2 Basic materials for suspension system: commercial quality cold rolled steel.
- .3 Suspension system: non fire rated, two directional exposed tee bar grid.
- .4 Exposed tee bar grid components for Acoustical Tile: 24 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. Grid sizes: 610 mm x 1219 mm imperial.
- .5 Hangers: galvanized soft annealed steel wire, 2.6 mm thick for all ceilings.
- .6 Carrying channels: of size, thickness and weight to carry spans; painted galvanized steel. Where spans exceed 1200 mm use channels of adequate strength.
- .7 Accessories: splices, clips, wire ties, retainers, shadow moulding and wall moulding to complement suspension system components, as recommended by system manufacturer.
- .8 ULC – approved hold-down clips where noted and required.

PART 3 EXECUTION

3.1 Installation

- .1 Supply and install hanger inserts to framing system, where required.
- .2 Do not erect ceiling suspension systems until anchors, blocking, sound or fire barriers, electrical and mechanical work above ceiling have been inspected and approved by Departmental Representative.
- .3 Lay out system according to reflected ceiling plan.
- .4 Ensure suspended system is coordinated with location of related components.
- .5 Install wall mould to provide correct ceiling height. Finished ceiling system to be level within 1:1200.
- .6 Support suspension system: Carrying channels, spaced to coordinate with hanger wire from building structural system. Completed assembly to support super-imposed loads such as lighting fixtures, diffusers, grilles and speakers.
- .7 Support recessed light mixtures with supplemental hangers within 150mm of each corner and at maximum 600mm around perimeter of fixture.
- .8 Attach cross member to main runner to provide rigid assembly.
- .9 Install suspension edge trim assemblies to manufacturer's instructions.
- .10 Frame at openings for light fixtures, air diffusers, speakers, and at changes in ceiling heights.

3.2 Cleaning

- .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Linoleum Sheet Flooring

1.2 References

- .1 American Society for Testing and Materials International (ASTM), latest editions:
 - .1 ASTM D2047 Standard Test Method for Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - .2 ASTM D2240 Standard Test Method for Rubber Property-Durometer Hardness.
 - .3 ASTM D395B Standard Test Methods for Rubber Property-Compression Set.
 - .4 ASTM D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products (VOC).
 - .5 ASTM E648-97 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - .6 ASTM F150 Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.
 - .7 ASTM F1914-98 Standard Test Method for Short-Term Indentation and Residual Indentation of Resilient Floor Covering.

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures.
- .2 Samples:
 - .1 Submit duplicate 300 x 300 mm sample pieces of sheet material and 300 mm long base.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for resilient flooring and rubber base for incorporation into manual specified in Section 01 78 00.

1.4 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Division 1.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Division 1 – Waste Management and Disposal.

1.5 Maintenance

- .1 Extra Materials:
 - .1 Provide extra materials of resilient flooring and adhesives in accordance with Division 1 – Closeout Submittals.
 - .2 Extra materials one piece and from same production run as installed materials.
 - .3 Identify each roll of sheet flooring and each container of adhesive.

- .4 Deliver to Departmental Representative upon completion of the work of this section.
- .5 Store where directed by Departmental Representative.

PART 2 PRODUCTS

2.1 Linoleum Sheet Flooring

- .1 2mm minimum thickness graded for commercial use. Resistant to diluted acids, oils, fats and to the conventional solvents, natural bacteriostatic properties, slip resistance (Minimum R9 Rating), made of natural materials.
- .2 For an example of an acceptable product, refer to Appendix A.

2.2 Accessories

- .1 Polyethylene sheet underlayer: 2 layers 6-mil, taped to form a continuous barrier, to CAN2-51.33-M77, Type 2.
- .2 Rubber Base: cont. 100mm Rubber Base.

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 Examination

- .1 Verify that spaces to receive resilient flooring and base are suitable for installation. Do not proceed with work until unsatisfactory conditions are corrected. Comply with manufacturer's recommendations including the following:
 - .1 Substrate shall be dry and clean.
 - .2 Substrates shall be free of depressions, residual mastics, raised areas or other defects which would telegraph through installed flooring.
 - .3 Temperature of resilient flooring and substrate shall be within specified tolerances.
 - .4 Moisture condition and adhesive bond tests shall be performed as required.

3.3 Preparation

- .1 Comply with ASTM F710-92 and manufacturer's recommendations for surface preparation. Remove substances incompatible with resilient flooring adhesive by method acceptable to manufacturer.
- .2 Vacuum sub-floors immediately prior to installation to remove loose particles.

3.4 Installation

- .1 Install resilient flooring in accordance with manufacturer's printed installation instructions. Comply with the following:
 - .1 Layout resilient flooring to provide equal size at perimeter. Adjust layout as necessary to eliminate resilient flooring which is cut to less than half-full width.
 - .2 Lay resilient flooring with arrows in the same direction.
 - .3 Install resilient flooring without cracks or voids at seams. Lay seams together without stress. Remove excess adhesive immediately.
 - .4 Scribe resilient flooring neatly at perimeter and obstructions.
 - .5 Extend resilient flooring into reveals, closets and similar openings.
 - .6 Terminate flooring at centre line of door in openings where adjacent floor finish or colour is dissimilar.
 - .7 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.7 Maintenance

- .1 Protection of Finished Work
 - .1 Protect new floors until just before final inspections.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 33 00 Submittals
- .2 Section 01 74 21 Waste Management and Disposal
- .3 Section 01 78 00 Closeout Submittals

1.2 References

- .1 The current publications of the following:
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.129-93, Carpets for Commercial Use.
 - .2 CAN/ULC-S102.2-2003, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
- .3 Carpet and Rug Institute (CRI)
 - .1 CRI TM101-03 Assessment of Carpet Surface Appearance Change.
 - .2 CRI TM 102-Fluorochemical Finishes.
 - .3 CRI-104 02, Standard Installation of Commercial Carpet.
 - .4 IAQ, Indoor Air Quality Carpet Testing Program.
- .4 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D1335-03, Tuft Bind of Pile Floor Coverings.
 - .2 ASTM D3936-02, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
 - .3 ASTM D5848-05, Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
- .5 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC 16E-2004, Color Fastness to Light.
 - .2 AATCC 134-2001, Electrostatic Propensity of Carpet.
 - .3 AATCC 174-1998, Antimicrobial Activity Assessment of Carpets.
 - .4 AATCC 175-2003, Stain Resistance: Pile Floor Coverings.
 - .5 AATCC 189-2002, Fluorine Content of Carpet Fibers.
- .6 National Floor Covering Association (NFCA)
 - .1 Floor Covering Specification Manual 1998.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.3 Submittals

- .1 All submittals shall be in accordance with Section 01 33 00 – Submittals.
- .2 Submit report outlining proposed dust control measures.
- .3 Submit carpet schedule using same room designations indicated on drawings.
- .4 Submit product data sheet for each carpet tile, adhesive concrete floor filler and sealer including:
 - .1 Physical and performance test results, labelling and certifications.
 - .2 Certificate demonstrating compliance with CAN/ULC S102.2.
 - .3 Written proof of testing and compliance with the Indoor Air Quality (IAQ) Carpet Testing Program requirements of CRI.
 - .4 Manufacturer's guarantee.
 - .5 Verification of recycled content and/or recyclability.
 - .6 Carpet size, pattern and colours.
 - .7 Manufacturer's installation instructions.
- .5 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for primers, levellers and adhesives. Indicate VOC content.
- .6 Submit samples of each type, minimum sizes:
 - .1 Carpet tile, 250 mm x 1000 mm.
 - .2 150 mm long divider/transition strips.
- .7 Submit maintenance data, include:
 - .1 Maintenance procedures and recommendations for maintenance materials and equipment.
 - .2 Suggested schedule for cleaning.

1.4 Quality Assurance

- .1 Installer Qualifications:
 - .1 Flooring contractor requirements:
 - .1 Specialty contractor normally engaged in this type of work, with prior experience in installation of these types of materials.
 - .2 Certified by carpet manufacturer to install specified product.
 - .2 Be responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturers written instructions.

1.5 Delivery, Storage and Handling

- .1 Label packaged materials. For carpet tile products indicate nominal dimensions of tile and indicate installation direction.
- .2 Packaging, labelling, packing and marking details.

- .3 Store packaged materials in original containers or wrapping with manufacturer's seals and labels intact.
- .4 Store carpeting and accessories in location as directed by Departmental Representative. Store carpet and adhesive at minimum temperature of 18°C and relative humidity of maximum 65% for minimum of 48 hours before installation.
- .5 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
- .6 Store materials in area of installation for minimum period of 48 hours prior to installation.
- .7 Modular carpet: store on pallet form as supplied by Manufacturer. Do not stack pallets.

1.6 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal, and with Waste Reduction Workplan.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.

1.7 Environmental Requirements

- .1 Moisture: Ensure substrate is within moisture limits and alkalinity limits prescribed by manufacturer. Prepare moisture testing and provide report to Departmental Representative.
- .2 Temperature: Maintain ambient temperature of not less than 18 oC from 48 hours before installation to at least 48 hours after completion of work.
- .3 Relative humidity: Maintain relative humidity between 10 and 65% RH for 48 hours before, during and 48 hours after installation.
- .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .5 Ventilation:
 - .1 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.
- .6 Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.
- .7 Install carpet only after all work of other trades has been finished in the area concerned and no more construction traffic is anticipated. Where prevention of tracking of dirt is impossible, provide protective covers as specified.

- .8 Perform carpet work of each work phase in a continuous period to minimize inconvenience to building Facility due to ventilation.
- .9 Where fumes and odours cannot be satisfactorily removed from the building interior, perform carpet work during weekend off-hour workshifts.
- .10 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.8 Extra Materials

- .1 Provide extra materials of carpet, carpet base, and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 2 m² of each colour, pattern and type of carpeting.
- .3 Extra materials to be from same production run as installed materials.
- .4 Identify each package of carpet and each container of adhesive.
- .5 Deliver to Departmental Representative and store where directed by Departmental Representative.

1.9 Guarantee and Warranty

- .1 Manufacturer's Guarantee
 - .1 Provide a minimum fifteen (15) year non-prorated labour and material carpet manufacturer's guarantee issued in the name of her Majesty the Queen in right of Canada, to cover, without the use of chair pads and allowing traffic immediately upon carpet installation the following:
 - .2 Maximum 15% loss of pile fiber weight tested as per ASTM D5848, mass per unit, area of pile yard, floor coverings.
 - .3 Maximum 10% loss of secondary backing resiliency calculated using average thickness.
 - .4 No edge ravel, zippering or delamination of secondary backing.
 - .5 Manufacturer's Guarantee shall begin from the date of issue of Final Certificate of Completion.
 - .2 Installation warranty
 - .1 Provide a total of 24 months warranty in addition to the 12 month prescribed in the General Conditions.

PART 2 PRODUCTS

2.1 General Carpet Tile Requirements

- .1 Manufacturer:
 - .1 Certified to Carpet and Rug Institute's and IAQ requirements.
 - .2 Have an on-going in-plant sustainable and recycling program in place.

- .2 Carpet Tile: to CAN/CGSB-4.129 and as follows:
 - .1 Certified for flammability to Health Canada regulations under "Hazardous Products (Carpet) Regulations", Part II of the Schedule.
 - .2 Maximum flame spread rating of 300 and maximum smoke developed classification of 500 when tested to CAN/ULC-S102.2.
 - .3 Certified to Carpet and Rug Institute's IAQ requirements and bear CRI-IAQ Label.
- .3 Performance:
 - .1 Appearance Retention Rating: minimum value of 3.0 to CRI Grading as per Test Method 101.
 - .2 Static control: to AATCC 134, maximum of 3.0 KV at 20% RH and 22°C, incorporated into carpet by permanent means and without chemical treatment.
 - .3 Delamination: minimum 8.5 N/cm (5.0 lbs/inch) to ASTM D-3936.
 - .4 Colourfastness to light: to AATCC 16E, minimum rating of 4.0 after 40 hours.
 - .5 Soil Resistance: minimum 350 parts/million fluorine, Fluorine Durability Level to AATCC 189.
 - .6 Stain resistance: to AATCC 175, minimum rating of 6.
 - .7 Anti-microbial: to AATCC 174, 99% reduction, 0% growth.
 - .8 Dimensional Stability: maximum 0.2% to DIN STD. 54318-AACHEN test.
 - .9 Toxicity: pass CRI IAQ Testing Program Green Label Plus.
- .4 Recycled Content:
 - .1 Postconsumer and preconsumer as defined in US EPA Comprehensive Procurement Guidelines.
 - .2 Recyclable as defined in FTC Part 260 – Guidelines for the use of Environmental Marketing Claims, Section 260.7(d).
 - .3 Percentage by weight of recovered material, calculated by dividing weight of recovered materials content in one square unit of area of finished carpet (consisting of pile, backing, and attached cushion, if any) by total weight of one square unit of area of finished carpet, and multiplying by 100.
 - .4 Comply with at least one of the following three requirements:
 - .1 Product contains a minimum 5% by weight of postconsumer materials recycled content, except that vinyl-backed and other similar hard-backed products contain 20% by weight of postconsumer materials recycled content.
 - .2 Product contains a minimum 15% by weight of recovered materials (which includes both preconsumer and postconsumer materials).
 - .3 Product contains a minimum 25% by weight of recyclable content and a recycling program is in place and operational.

2.2 Type "CP-1" Carpet Tile

- .1 250 x 1000 mm tufted textured patterned cut and loop nylon modular carpet tile conforming to the following properties:
 - .1 Construction Textile Composite
 - .2 Backing System: Polyester Felt Cushion
 - .3 Dye Method: Solution Dyed
 - .4 Wear Layer Polyester- Applied Pattern
 - .5 Pattern repeat N/A
 - .6 Total Weight 4.5 oz - 5.2 oz/ square foot.
 - .7 Total Thickness .205 inches
 - .8 Dimensions: 12" x 48" modules
 - .9 Total Recycled Content: 55.8%
- .2 Colour and Finish: Refer to the Appendix A Finish and Colour Schedule.

2.3 Accessories

- .1 Adhesive:
 - .1 Releasable or peel and stick, mill applied, low odour/low VOC complying with CRI IAQ testing program requirements and criteria.
 - .2 Select adhesive based on the lowest level of chemical emissions released during application and curing. Where more than one adhesive is suitable and the emission rates are similar, use the adhesive of least toxic or irritant to humans.
- .2 Carpet protection: non-staining heavy duty kraft paper.
- .3 Concrete floor sealer: to CAN/CGSB-25.20, Type 1.
- .4 Subfloor filler and leveller:
 - .1 Purpose made Portland cement based polymer modified compound, capable of achieving minimum compressive strength of 30 MPa once cured, mixed on site with latex liquid additive and water.
 - .2 Capable of achieving a feather edge.
 - .3 Specifically formulated as a high impact traffic topping and levelling material, non-dusting type.
 - .4 Low odour/low VOC content.
 - .5 Compatible with carpet tile flooring.
 - .6 Use of gypsum based levellers are not acceptable.
- .5 Transition strips:
 - .1 Vinyl type with lip to extend under floor finish, cap both sides over top of adjacent floor finishes. Cap height to suit floor finish height and accommodate

underside of door clearance. Colour as selected by Departmental Representative from manufacturer's full colour range.

PART 3 EXECUTION

3.1 Sub-Floor Treatment

- .1 Concrete shall be inspected to determine special care required to make it a suitable foundation for carpet. Cracks 3 mm wide or protrusions over 0.8 mm will be filled and levelled with appropriate and compatible latex patching compound.
- .2 Do not exceed manufacturer's recommendations for patch thickness.
- .3 Large patch areas are to primed with a compatible primer.
- .4 Concrete substrates shall be cured, clean and dry.
- .5 Concrete substrates shall be free of paint, dirt, grease, oil, curing or parting agents, and other contaminates, including sealers, that may interfere with the bonding of the adhesive.
- .6 Wherever a powdery or porous concrete surface is encountered, a primer compatible with the adhesive shall be used to provide a suitable surface for glue-down installation.

3.2 Preparation

- .1 Prepare floor surfaces in accordance with CRI 104 Standard for Installation of Commercial Carpet.
- .2 Pre-condition carpeting following manufacturer's printed instructions.

3.3 Installation

- .1 Install carpeting using minimum of pieces.
- .2 Install in accordance with manufacturer's printed instructions and in accordance with Carpet and Rug Institute Standard for Installation of Commercial Carpet, CRI 104.
- .3 Install carpet after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.
- .4 Finish installation to present smooth wearing surface free from conspicuous seams, burring and other faults.
- .5 Use material from same dye lot. Ensure colour, pattern and texture match within any one visual area. Maintain constant pile direction.
- .6 Fit neatly around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .7 Install carpeting to access covers.
- .8 Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .9 Install carpet smooth and free of bubbles, puckers, and other defects.

3.4 Seams

- .1 Seal edges of cut-outs with latex.
- .2 Carpet visibility of seams and joints to acceptable industry standards.

3.5 Base Installation

- .1 Install cove at junction of floor and wall.
- .2 Install resilient base in accordance with Section 09 65 00.

3.6 Protection of Finished Work

- .1 Vacuum carpets clean immediately after completion of installation. Protect traffic areas.
- .2 Prohibit traffic on carpet for a period of 24 hours until adhesive is cured.
- .3 Install carpet protection to satisfaction of Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 All work and materials shall conform to the standards to the Master Painters Institute (MPI) Maintenance Repainting and Architectural Painting Specification Manuals, latest editions, and as herein specified, indicated on drawings and schedules.
- .2 This section of work shall include all labour, materials, tools, scaffolds and other equipment, services and supervision required to prepare surfaces and to cover them with paint and/or stain as herein specified and as shown on the "Finish Schedule", to the full intent of the specifications.
- .3 Include certain scheduled previously painted and transparent finished surfaces and new unpainted / unfinished surfaces.

1.2 Work Excluded

- .1 All factory and pre-finished items not scheduled and specified for painting.
- .2 Shop-finished millwork shall conform to these specifications.

1.3 Requirements of Regulatory Agencies

- .1 This work section requires full cooperation at all times with the MPDA in the performance of its duties.

1.4 Qualifications

- .1 The paint products of the Paint Manufacturer shall be as listed in the MPI Maintenance Repainting and Architectural Painting Specification Manuals (latest edition), under "Paint Product Recommendation" section, or approved equivalent.
- .2 This contractor shall have a minimum of five (5) years proven satisfactory experience, and shall maintain a qualified crew of painters throughout duration of the work who shall be qualified to fully satisfy the requirements of this specification. Only qualified journeymen (and apprentices) shall be engaged in painting and decorating work who have a provincial Tradesman Qualification certificate of proficiency.
- .3 Painting and decorating inspection shall be performed by an Inspector assigned by the MPDA, this includes inspection of shop-finished millwork.

1.5 Submittals

- .1 Submit a written request to the Departmental Representative for approval of Products from MPDA schedule, listing each of the materials proposed and surfaces to be covered. State clearly manufacturer's name, brand name of material, and manufacturer's product code.
- .2 Paint colours shall be selected by Departmental Representative.

1.6 Product Handling

- .1 Paint materials shall be delivered to the job site in sealed original labelled containers bearing manufacturer's name, type of paint, brand name, designation and instruction for mixing and/or reducing.
- .2 The Contractor shall provide adequate storage facilities. Paint materials shall be stored at a minimum ambient temperature of 7°C in a well ventilated and heated single designated area.
- .3 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.
- .4 Where toxic materials and both toxic and flammable solvents are used, appropriate precautions shall be taken and no smoking allowed as a regular procedure.

1.7 Environmental conditions

- .1 Temperature, humidity and moisture content shall conform to the following:
Temperature: No painting shall be performed when temperature on the surfaces, or the air in the vicinity of the painting work are below 5°C (41°F) for interior work and 10°C (50°F) for exterior work.
Relative Humidity: Shall not be higher than 85%.
Moisture of Surfaces: Tests shall be done by electronic "Moisture Metre".
Wood: Maximum moisture content 12%.
- .2 Proper lighting shall be the Painting Contractor's responsibility.
- .3 All areas where painting and decorating work is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7°C (45°F) for 24 hours before and after paint application. Required heat and ventilation shall be provided by the Painting Contractor.

1.8 Protection

- .1 Adequately protect other surfaces from paint and damage and make good any damage caused by failure to provide suitable protection, but this section will not be responsible for any damage caused by others.
- .2 Furnish sufficient drop cloths, shields and protective equipment to prevent spray of dropping from fouling surfaces not being painted and in particular, surfaces within the storage and preparation area.
- .3 Cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .4 Remove all surface hardware, electrical plates, fittings, fastenings, etc. prior to painting operation. These items shall be carefully stored, cleaned and replaced on completion of work in each area.

1.9 Quality Control

- .1 The MPI Quality Assurance Program shall be in effect, and the inspection for the surfaces and of the application shall be by an Inspection Agency (inspector) assigned by the AQA Association. The inspection shall be in accordance with the standards contained throughout the MPI Manuals, and is applicable to contractors supplying the AQA Association's Two Year Guarantee.
- .2 Alkali content tests, and such other tests as shall be necessary, (e.g. moisture content, lighting, etc.) shall be performed by the Paint Inspector.

1.10 Finishing of Shelving

- .1 With the exception of touch-up, schedule new shelving shall be shop finished.

1.11 Guarantee

- .1 The Painting Contractor shall furnish the local MPI Accredited Quality Assurance Association's guarantee, in accordance with MPI Manuals requirements. The Guarantee shall cover making good defects in the painting work done under the specification due to faulty workmanship or defective materials supplied by the Painting Subcontractor which appear during a two (2) year period following "substantial" completion of the repainting.
- .2 All work shall be in accordance with the MPI Maintenance and Architectural Painting Specification Manuals requirements and shall be inspected by the MPI Accredited Quality Assurance Association's guarantee, or the Maintenance Bond option.

PART 2 PRODUCTS

2.1 Materials

- .1 Paint, varnish, stain, enamel, lacquer, and fillers used shall be of a type and brand herein specified and listed under "Paint Product Recommendations" as covered in the MPI Architectural Painting Specification Manual, latest edition, for specific purposes.
- .2 Paint materials such as linseed oil, shellac, turpentine, etc. and any of the above materials not specifically mentioned herein but required for first class work with the finish specified shall be of the highest quality product of an approved manufacturer. All coating material shall be compatible.
- .3 All materials shall be lead, hex. chromium, cadmium and mercury free and shall have low VOC content.
- .4 Preference should be given to ISO 2002 registered manufacturers.
- .5 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project. Provide paint products meeting MPI "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels. Use MPI listed materials having minimum rating where indoor air quality (odour) requirements exist.
- .6 All material shall be premium Architectural grade unless otherwise specified.

PART 3 EXECUTION

3.1 General

- .1 Method of paint application shall be generally by the accepted trade method. Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with recommendations.
- .2 Apply each coat at the proper consistency. Each coat of paint shall be slightly darker than preceding coat unless otherwise approved.
- .3 Sand lightly between coats to achieve the required finish. Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise (4 hours for latex; 8 hours for alkyd).
- .4 Tint filler to match wood when clear finished are specified; work filler well into the grain and before it has set wipe the excess from the surface.
- .5 Application of paint shall be in strict accordance with MPI Architectural Painting Specification Manual requirements.
- .6 Complete hiding is required on all finishes, including deep tone colours.
- .7 Contractor shall employ sufficient tradesmen to carry out the job with no interruption, slow down or inconvenience to the project schedule and operations.

3.2 Condition of the Surfaces

- .1 Prior to commencement of work of this section, thoroughly examine all surfaces scheduled to be painted.
- .2 Report to Departmental Representative any condition adversely affecting this work.
- .3 No painting work shall proceed until all defects have been corrected and surfaces are acceptable for painting.
- .4 Commencement of work shall be held to imply acceptance of surfaces.
- .5 All preparation work shall be the responsibility of the Painting Contractor (Refer to Surface Preparation).

3.3 Preparation of Surfaces

- .1 Prior to commencement of work of this section, thoroughly examine all surfaces scheduled to be painted. Report to Departmental Representative any conditions adversely affecting this work. Prepare all interior surfaces for repainting in accordance with MPI Manual requirements.
- .2 No painting work shall proceed until all defects have been corrected and surfaces are acceptable for painting. All preparation work shall be the responsibility of the Painting Contractor.
- .3 Prepare all surfaces in accordance with the requirements in Chapter 3 of the MPI Architectural Painting Specification Manual (latest edition) and as herein specified.

- .4 Remove and securely store all miscellaneous surface fittings/fastenings (eg: electrical plates and frame stops), removable rating/hazard/instruction labels, prior to painting and replace upon completion. Carefully clean and replace all such items upon completion of repainting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (eg: lacquer finishes).
- .5 All surfaces shall be sanded prior to the application of any coatings.
- .6 Allow full drying between coats, as per manufacturer's recommendations. Sand in between coats.
- .7 Remove all loose and peeling paint from walls and woodwork to a sound surface.
- .8 Loose and peeling paint not meeting ASTM Designation D3359-87 Test Method A-X cut scale 2A shall have the entire surface(s) removed to a sound surface.
- .9 Repair all water damaged surfaces and spot prime with a stain blocking primer.
- .10 Surface defects, such as nail/screw popping, paper tears, nicks and scratches, line gauges caused by chair back seat rests, tables, etc., shall be filled, sanded and spot primed with an approved primer and shall be considered normal surface preparation.
- .11 Units severely contaminated with grease, smoke and tar – hand wash with detergent and rinse thoroughly prior to any surface preparation.
- .12 All surfaces: applications shall be by brush/roller, including smooth ceilings.
- .13 Allow full drying between coats, as per manufacturer's recommendations. Sand in between coats.
- .14 Surface defects such as old paint runs on walls and wood works must be sanded smooth prior to the applications of any coating(s).
- .15 Tape fill, sand and spot prime all structural cracks.
- .16 Remove clear tape from walls, ceilings, doors, etc. Remove felt pen graffiti from doors, walls, etc. before priming. Prepare and paint all mechanical and electrical services with the appropriate primers, as per MPI Architectural Specification Manual, latest edition.
- .17 Ensure that a transition primer is applied over alkyd surfaces where waterborne systems have been specified.

3.4 Mechanical and Electrical Equipment

- .1 Paint exposed conduits, pipes, hangers and other mechanical and electrical equipment occurring in finished areas. Colour and texture shall match adjacent surfaces, except as noted otherwise.
- .2 Keep sprinkler heads free of paint.
- .3 Paint both sides and edges of plywood back-boards for equipment, to visually match adjacent wall finishes.

3.5 Field Quality Control

- .1 In strict accordance with the MPI Architectural Painting Specifications Manual requirements.

3.6 Painting Schedule

Refer to Appendix A.

3.7 Existing Surfaces

- .1 Apply bonding primer #69 to all previously painted millwork, trim, steel handrails, doors and frames, bonding primer #17 to all wall surfaces in lieu of first coat.

3.8 Paint Colour Schedule

- .1 To be issued as a separate document at a later date.

3.9 Cleaning

- .1 Promptly as the work proceeds and on completion of the work, remove all paint where spilled, splashed or spattered; during the progress of the work keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris. At the conclusion of the work leave the premises neat and clean to the satisfaction of the Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Supply and install building evacuation plan signage.

1.2 Submittals

- .1 All submittals shall be in accordance with Division 1.
- .2 Shop Drawings:
 - .1 Submit shop drawings for work of this section.
 - .2 Include description of materials, finishing specifications, and all other pertinent information.
 - .3 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
 - .4 Digital proofs:
 - .1 Submit one complete set of colour digital proofs showing placement and typography of final graphic components and images.
 - .2 Proofs shall show final text and images, in place, scaled to accurately assess type spacing, overlay text on images, illustrations and graphic effects such as bleeds, graded colour, etc.
- .3 Mock-Up/ Samples:
 - .1 Provide when requested, at the Departmental Representative's discretion, mock-ups of items as requested by Departmental Representative.
- .4 Product Data Sheets:
 - .1 Submit manufacturer's product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturers' installation instructions.
- .5 Templates:
 - .1 Submit templates to Contractor for use by installers and fabricators as required for proper location and installation of signage.
- .6 Closeout Submittals:
 - .1 Submit closeout submittals in accordance with Division 1.
 - .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data instructions for signage and finishes.

1.3 Delivery, Storage and Handling

- .1 Package or crate, and brace and wrap Products to prevent damage during shipment and handling. Label packages and crates according to signage numbers as listed in the signage schedule, and protect finish surfaces from environmental conditions where required.
- .2 Deliver Products to location at building site designated by Contractor.
- .3 Provide methods for lifting or hoisting units into place without causing damage.

PART 2 PRODUCTS

2.1 Materials

- .1 Interior Signs: Acrylic: Methacrylate plastic with a minimum flexural strength of 16,000 psi, ASTM D790.
- .2 Coloured coatings for acrylic sheet: Non-fading coatings, including inks and paints for copy and background colours, recommended by acrylic manufacturers for optimum adherence to acrylic surface.

2.2 Fabrication

- .1 General: Produce smooth, even, level sign panel surfaces, constructed to remain flat when installed within a tolerance of +1.5 mm measured diagonally from corner to corner.
- .2 Laminated sign panels where utilized: Permanently laminate face panels to backing sheets, of material and thickness indicated, using manufacturer's standard process.
- .3 Copy application:
 - .1 Edges of letters, numbers or symbols shall be smooth with corners sharp and true.
 - .2 Forms shall be free of ticks, line waver, discontinuous curves and other imperfections.
 - .3 Submit samples of the range of colours and fonts available for signage for approval.
 - .4 Minimum font size shall be 18 mm.

2.4 Acrylic Signs

- .1 Surface and subsurface silkscreened acrylic signs:
 - .1 Silkscreen copy shall be photo-produced rather than hand cut seams using fine mesh screens and screening inks.
 - .2 Surface of letters shall be uniform in colour and finish and free of pinholes or other blemishes.
 - .3 Signs shall be consistent in colour, value and coverage, and shall maintain proper opacity or translucency and shall be free of blistering, fading and other imperfections.
 - .4 Sign colour registration shall be crisp, sharp and free of imperfections.

2.5 Building Evacuation Signs

- .1 Provide building fire evacuation plan signs in accordance with the 2018 British Columbia Building Code (BCBC).
- .2 Sign shall be of similar material and type to other interior signs in building.
- .3 Quantity, graphics and mounting locations in accordance with BCBC, 2018.

PART 3 EXECUTION

3.1 Installation

- .1 Examine surfaces to which signage is to be anchored and report any

unacceptable conditions. Commence work only after surfaces are acceptable.

- .2 Install in accordance with signage manufacturer's specifications and templates as required for installation of work of this section.
- .3 Install signage level and secure at locations indicated.

3.2 Adjustment and Cleaning

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at site only if acceptable.
- .3 Remove excess materials from the site.
- .4 Upon completion of the work of this section, or at such time or times as the Departmental Representative shall direct, remove protective coverings and clean down the finished work.
- .5 Clean adjacent surfaces which have been soiled or otherwise marred, in an acceptable manner, to completely remove evidence of material causing same.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|------------------------------|
| .1 | Section 06 10 00 | Rough Carpentry |
| .2 | Section 09 22 00 | Non-Structural Metal Framing |
| .3 | Section 10 05 00 | Miscellaneous Specialties |
| .4 | Division 22 | Plumbing |
| .5 | Division 26 | Electrical |

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM B456, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-B651, Barrier-Free Design.

1.3 Submittals

- .1 All submittals shall be in accordance with Division 1 – Submittal Procedures
- .2 Shop Drawings:
 - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in frame, building-in details of anchors for grab bars.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for washroom accessories for incorporation into manual specified in Division 1.

1.4 Extra Materials

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Division 1.
- .2 Deliver special tools to Departmental Representative.

1.5 Delivery, Storage and Handling

- .1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

PART 2 PRODUCTS

2.1 Washroom Accessory Materials

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 302 with No. 4 finish.
- .3 Stainless steel tubing: Type 304 commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields, fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.
- .5 All washroom accessories shall be the same design line of the same manufacturer.
- .6 Minimum standard for washroom accessories shall be Bobrick "Contra Series". Other products of ASI Watrous Inc. or Bradley Corp. will not be excluded.

2.2 Washroom Accessory Components

- .1 Un-framed mirrors (MI-1): refer to Section 08 80 00.
- .2 For all other accessories, refer to Appendix A.

2.3 Fabrication of Toilet Accessories

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on wall framing and components.
- .10 Lettering: for identification of accessories and operation instructions shall be silk screened using international symbols unless otherwise specified.

PART 3 EXECUTION

3.1 Examination and Preparation

- .1 Verification of conditions: examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion. Do not proceed until unsatisfactory conditions have been corrected.

- .2 Surface preparation: prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
- .3 Protection: take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.2 Installation (General)

- .1 Install all components in strict accordance with manufacturer's written instructions.

3.3 Coordination/Cooperation

- .1 Coordinate work of this Section with that of Division 22 for plumbing.
- .2 Coordinate work of this Section with Section 09 22 00 for wall framing.
- .3 Coordinate work of this Section with Section 06 10 00 for wood blocking.
- .4 Coordinate work of this Section with Division 26 – Electrical.

3.4 Installation of Washroom Accessories

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
- .2 Install accessories to permit operable parts and controls to be accessed in accordance with accessibility requirements of NBCC, 2015 and BCBC, 2018.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.

3.5 Washroom Accessory Location Schedule

- .1 Locate washroom accessories where indicated on drawings.

3.6 Cleaning and Protection

- .1 Immediately upon completion of installation, clean materials in accordance with manufacturer's recommended cleaning method.
- .2 Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.
- .3 Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

PART 1 GENERAL

1.1 Reference Standards

- .1 Perform work in accordance with the recommendations and requirements of:
 - .1 National Fire Protection Association, NFPA 10 – Standard for Portable Fire Extinguishers.
 - .2 National Building Code of Canada 2018

1.2 Submittals

- .1 All submittals shall be in accordance with Division 1 - Submittal Procedures.
- .2 Submit shop drawings (showing locations and mounting details) and product data for the extinguishers and extinguisher cabinets.

1.3 Maintenance Data

- .1 Provide maintenance data for incorporation into the Mechanical Operation and Maintenance Manuals, as per Division 1.

PART 2 PRODUCTS

2.1 Products

- .1 Semi-Recessed Cabinet with Extinguisher:
 - .1 203mm wide x 431mm high x 127mm deep cabinet.
 - .2 Full length semi-concealed piano hinges for 180 degree swing.
 - .3 Flush stainless steel door latch with no exposed fasteners.
 - .4 22 gauge steel tub.
 - .5 16 gauge steel door and trim with optional 5 mm clear tempered glass.
 - .6 Grey prime coated finish ready for field painting.
 - .7 4.5 kg (10 lb) ABC dry chemical multipurpose fire extinguisher.
 - .8 Accepted product: NFE model 102F-VD (recessed) extinguisher cabinet.
 - .9 Provide surface-mounted cabinets, equivalent to the above, at concrete block masonry wall locations.

2.2 Quantity and Locations

- .1 The Fire Extinguisher supplier shall determine the type, quantity and location of the cabinets based on NFPA 10, NBCC 2015, the Building Occupancy Classification and mechanical drawings. Locations shall be approved by the Departmental Representative.

PART 3 EXECUTION

3.1 Installation

- .1 Install fire extinguishers in cabinets at locations as directed by Departmental

Representative.

- .2 Coordinate locations of fire extinguisher cabinets with Sections 05 41 00, 06 10 00, 09 22 00 and 09 29 00 in order to facilitate recessed and semi-recessed installations, as well as the provision of solid wood blocking in stud spaces.
- .3 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1200mm above the floor.
- .4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to the project substantial completion review by the Departmental Representative.

3.2 Identification

- .1 Identify fire extinguishers in accordance with the recommendations to NFPA 10.
- .2 Attach a tag or label to all fire extinguishers, indicating the month and year of installation, with space for recording subsequent service dates.

END OF SECTION

Part 1 GENERAL

1.1 Work Included

- .1 Manually operated chain and sprocket roller shade assembly for installation on interior side of new windows where indicated.

1.2 Samples

- .1 Submit one representative working sample of assembly along with samples of shade fabric for colour and pattern selection in accordance with Division 1.

1.3 Design

- .1 Roller Shade manufacturer shall be responsible for the design of the system for application within the mullion spacing and configuration of the glazing system.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Division 1.
- .2 Indicate dimensions in relation to mullions, operator details, head and anchorage details, hardware and accessories details.
- .3 Submit sample of shade fabric to Departmental Representative for approval.

Part 2 PRODUCTS

2.1 Operation

- .1 Manual easy-lift chain operated action with infinite positioning. Left or right hand operation.

2.2 Component Assembly

- .1 Fully factory assembled shade unit consisting of 2 end brackets, shade tube, extruded aluminum fascia, hembar and fabric specified. Mounting type: face of mullions. Removal must not require the disassembly of the shade unit.
- .2 End Bracket: the 77 x 96 mm end bracket shall be a two piece moulded ABS construction with a 64 mm diameter nylon drive sprocket. Brackets colour shall coordinate with the fascia colour.
- .3 Shade Tube: 38 mm extruded aluminum shade tube shall be 1.52 mm thick with three internal continuous fins 4.82 mm high, for strength and drive capabilities when attached to the nylon sprocket. The fins shall be spaced 120 degrees apart.
- .4 Fascia: the extruded aluminum fascia shall be 1.7 mm thick, complete with three continuous screw flute, anodized or custom painted.
- .5 Drive Assembly:

- .1 Shall be factory set for size and travel shades.
- .2 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.
- .3 Provided with a built-in shock absorber system to prevent chain breakage, under normal usage conditions.
- .6 Drive Chain: Shall be No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have a 90 # test.
- .7 Exterior Hembar: extruded aluminum with plastic end finals. Finish – Clear Anodized.

2.3 Shading Fabric

- .1 Shade cloths shall be woven of 0.018 opaque, vinyl coated polyester yarn consisting of approximately 79% vinyl and 21% 500 denier polyester core yarn. The fabric shall be tensioned in the finishing range prior to heat setting to keep the warp ends straight and minimize or eliminate weave distortion to keep the fabric flat. The fabric shall be dimensionally stable. Colour shall be as by Departmental Representative selected from standard range.
- .2 Fabric shall conform to following standards:
 - .1 Composition: 25% polyester, 75% PVC.
 - .2 Mesh Weight: 21 (oz./yd²)
 - .3 Yarn diameter (in.): 0.20 warp and fill.
 - .4 Fabric Thickness (in.): 0.037.
 - .5 Openness Factor: Approximately 3%.
 - .6 Flame Resistance: CAN/ULC-S-109-Pass, NFPA-701-small scale-pass.
 - .7 Breaking Strength (lb.): 340/250 (warp/fill)
 - .8 Stretch: (%) 1.5/4.0 (warp/fill)
- .3 As a “shade cloth” the fabric shall hang flat, without buckling or distortion. The edge. When trimmed, shall hang straight without raveling. An unguided roller shade direction due to warp distortion, or weave design.

2.4 Accepted product

- .1 “Teleshade System” with “Solarblock 300 Series” (3% open) shade fabric as manufactured by Solarfective Products Ltd. And distributed by Cascadia Design Products of Vancouver, BC. Other products having the same characteristics will not be excluded.

Part 3 EXECUTION

3.1 Preparation

- .1 Shade supplier shall be responsible for all field measurements and templating.

3.2 Installation

- .1 Install bracket mounted roller shades in accordance with manufacturer's instructions.
- .2 Secure head rails to mounting angles with stainless steel screws. Use non corrosive metal fasteners for installation, conceal in final assembly.
- .3 Install roller shades square, true to line with operable parts adjusted for correct function.
- .4 Install roller shades full height and width, where shown and scheduled.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This is a performance specification for the provision of all labour and materials necessary to install a complete and ready for continuous operation, fire suppression system for this project. The systems shall be as indicated in the contract documents and as required by the referenced codes and the Authority having jurisdiction.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts. For general conditions, refer to Section 23 05 02 Heating, Ventilation, and Air Conditioning.
- .2 Provide Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for fire suppression systems.
- .3 Shop drawings: Provide a minimum of four (4) sets of the following stamped and signed by a Professional Engineer registered or licensed in Province of British Columbia:
 - .1 Hydraulic calculations for sprinkler design.
 - .2 Detailed piping and sprinkler head layouts.
 - .3 Manufacturer's catalog data including specific model and size for all equipment.

1.3 General Requirements

- .1 The fire suppression contractor shall retain the services of a Professional Engineer registered in the Province of British Columbia (Fire Suppression Engineer) to provide complete engineering design and field review services including signed and sealed CAD fire suppression drawings and hydraulic calculations.
- .2 Design systems for earthquake protection for buildings in seismic zone.
- .3 Design system in accordance with ANSI/NFPA 13, using the following parameters:
 - .1 In the absence of requirements from the Authority having jurisdiction:
 - .1 Pipe Schedule or Hydraulic calculations

1.4 Substantial & Total Performance

- .1 A certificate of Substantial Performance will not be granted unless the Fire protection systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the Contractor to have a substantial completion inspection.

2. PRODUCTS

2.1 General

- .1 All materials shall be ULC Listed for the intended service and shall be supplied in original factory packaging.
- .2 Piping, valves, and sprinkler types shall match the base building standard.
- .3 All sprinklers shall be to ANSI/NFPA 13 and ULC listed for fire services.
- .4 All sprinklers shall be for commercial applications unless stated otherwise. Residential sprinklers are only permitted in residential areas of residential buildings.
- .5 Provide firestopping.

2.2 Pipe, Fittings and Couplings

- .1 Provide for all pipe, fittings, couplings, valves, nipples, drains, test connections, and all accessory pipe work for a complete installation within the base tender price.
- .2 No extra cost will be considered based on failure of the contractor to allow for pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether indicated on the drawings or not.
- .3 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .4 Provide one piece escutcheon plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .5 All exposed sprinkler pipes shall be copper piping painted.

2.3 Valves

- .1 All sprinkler valves to be ULC or UL listed and FM approved.
- .2 Test and Drain Valves - 1210 kPa (175 psi) - ULC listed
 - .1 NPS 1-1/2 to NPS 2: Cast bronze construction, tapped gauge outlet, and integral sight glass.
 - .2 NPS 1 and NPS 1-1/4: Forged brass construction, tapped 6 mm (1/4") gauge outlet, and integral sight glass.

2.4 Sprinklers

- .1 All sprinklers shall be to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss in the sprinkler body.
- .3 Sprinklers with rubber O-rings are not permitted.

- .4 All sprinklers in exposed areas subject to viewing by the building occupants shall be chrome plated finish with matching escutcheons. All sprinklers in service spaces, mechanical and electrical rooms and other spaces subject to view by the maintenance staff of the building may be in natural plain brass finish.
- .5 Provide dry upright, dry pendant or dry sidewall sprinklers as required to serve areas subject to freezing served from wet sprinkler system piping.
- .6 The finished escutcheon shall not project more than 4 mm (1/4") below the finish ceiling surface. The escutcheons shall match the sprinkler finish, be of the same manufacturer as the sprinkler and shall coordinate with architectural features of the building.
- .7 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.5 Flow Switches

- .1 Provide 24V DC with both normally open and normally closed contacts, time delay and paddle indicator. Switch to be ULC listed for pipe size the flow switch is mounted on.
- .2 Provide test and drain assembly immediately downstream of each flow switch in addition to normal inspector's test connections required by NFPA 13 requirements.
- .3 Flow switches shall be manufactured specifically for use in sprinkler systems.
- .4 Rated working pressure 1210 kPa (175 psi).
- .5 Flow switches installed in hazardous locations shall be listed for use in hazardous locations.

2.6 Supervisory Switches

- .1 24V DC supervisory switches, ULC listed complete with 1 set of normally open contacts and 1 set of normally closed contacts or 2 sets of SPDT contacts.
- .2 Looped cable devices are not acceptable.
- .3 Approved valves with integral and/or factory installed indicators and supervisory controls are acceptable products.
- .4 Supervisory switches installed in hazardous locations shall be listed for use in hazardous locations.

2.7 Backflow Prevention Stations

- .1 Provide a ULC Listed double check valve assembly (DCVA) complete with O.S. & Y. inlet and outlet shut-off valves.
- .2 Backflow prevention stations shall be in complete accordance with the manual "Cross Connection Control Manual" published by the Pacific Northwest Section of the American Water Works Association.
- .3 Isolation valves shall be provided with supervisory switches connected to supervisory signals at the fire alarm system.

2.8 Spare Sprinklers

- .1 Provide a red baked enamel steel cabinet in location designated or located adjacent to alarm valves for storage of maintenance materials, spare sprinkler heads, and special tools.
- .2 Provide a minimum of two (2) spare sprinklers heads of each type and temperature rating used on the Project.
- .3 Provide suitable wrenches for each sprinkler type.
- .4 Provide a list of the sprinklers installed in the property, posted in the sprinkler cabinet to NFPA 13.

2.9 Fire Stopping

- .1 Materials, accessories, and application procedures listed by ULC cUL, or tested in accordance with CAN/ULC-S115 to comply with building code requirements.
- .2 Fire stopping Materials: CAN/ULC-S101 ASTM E119 ASTM E814 to achieve a fire rating as noted on Drawings.
- .3 Surface Burning: CAN/ULC-S102 ASTM E84 with a flame spread/smoke developed rating of 25/50.
- .4 Installer shall be certified, licensed, or otherwise qualified by the fire stopping manufacturer as having the necessary training to install the manufacturer's products to specified requirements. On request, the certified installer shall provide documented proof of certification from the firestop system manufacturer. A manufacturer's willingness to sell its firestop products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

2.10 Portable Fire Extinguishers (FE-1)

- .1 Multi-Purpose Dry Chemical – Pressure Type Extinguisher:
 - .1 Description: Multipurpose stored pressure rechargeable fire extinguisher, squeeze grip positive on/off operation, heavy duty steel cylinder with gloss enamel finish, pull pin safety lock, forged valve, hose and nozzle, with universal wall mounting bracket.
 - .2 Capacity: 2.25 kg (5 lbs) OR 4.5 kg (10 lbs)
 - .3 ULC Rating: 3-A, 40-BC OR 4-A, 80-BC
 - .4 Classification: Class A, B, and C fires

2.11 Clean Agent Extinguisher (FE-2)

- .1 Description: Stainless steel shell and non-magnetic valve, hose and nozzle. Easy grip handle with ring pin and retention chain. Extinguisher shell factory hydrostatically tested to 4130 kPa (600 psi), with universal wall mounting bracket.
- .2 Zero ozone depletion potential

- .3 Factory charged with FE-36 that is a colorless, odorless, electrically non-conductive, residue free, low toxicity agent.
- .4 Capacity: 6 kg (13-1/4 lbs)
- .5 ULC Rating: 2A, 10BC
- .6 Classification: Class A, B, and C fires

3. EXECUTION

3.1 Installation

- .1 For underground piping comply with AWWA C600 – Installation of Ductile Iron Water Mains
- .2 Polyvinyl chloride (PVC) piping used for underground water supply lines shall adapt to approved non-plastic material prior to penetration through the exterior building wall or floor slab.
- .3 PVC systems shall be installed to the Manufacturers listing limitations.
- .4 Provide thrust blocks and tie rods on all underground sections of piping.
- .5 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.
- .6 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.
- .7 Flush all underground water mains and fire department connection lines before connecting to the fire suppression systems.
- .8 Install equipment in accordance with manufacturer's instructions.
- .9 Install approved monitored valves and flow switches for all zones. Monitored valves and flow switches shall be wired to central fire alarm system by Division 26. Identify each valve by indicating which zone is controlled by each valve. Ensure devices are connected as required to the fire alarm system. Coordinate with Division 26.
- .10 Install spare parts cabinet in location designated or located adjacent to alarm valves. Coordinate with owner and consultant.
- .11 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.
- .12 Provide expansion joints or flexible couplings at building expansion joints, [building earthquake joints], building firewalls, and other locations as required.
- .13 All grooved end components including valves, fittings, and couplings shall be of one manufacturer.
- .14 Run sprinkler piping in heated joist spaces to avoid bulkheads. Coordinate with structural for any drilling – coring of joist.
- .15 Flush entire piping system until effluent is clear and free of debris. Minimum flush time of 2 hours. Rate of flushing flows shall be as indicated in NFPA-13.

3.2 Isolation Valves

- .1 Install isolation valves whether shown on the drawings or not at the following locations:
 - .1 At the base of each standpipe riser.
 - .2 At each sprinkler zone.
 - .3 At all points where required by the Building Codes, By-Laws or NFPA

3.3 Electrical Equipment Protection from Water

- .1 Responsibility for water damage to electrical equipment from the sprinkler system installation whether due to testing or leakage prior to the Owner's acceptance of the building shall be the responsibility of this Section.

3.4 Field Quality Control

- .1 The Fire Suppression Engineer shall perform all field services as required to fulfil the Building Code obligation for the provision of the Assurance of Professional Field Review and Compliance Schedule C-B for fire suppression systems and seismic restraint of fire suppression systems.
- .2 The Fire Suppression Engineer shall provide field reviews on a monthly basis (minimum) throughout the duration of the project. Submit concise field reports to the Owner's Consultant within 3 days of each site review.
- .3 Allow for destructive testing of 5% of fire stopping applications. Should installations not conform to manufacturer's listed assembly, an additional 25% of installations may be destructively tested and should there be more failures, the contractor will be responsible to remove all fire stopping products and reinstall products correctly, at no additional cost to the project.
- .4 Firestopping shop drawings shall be on site at all times to provide reference for the consultant, Engineer of record and building authorities.

3.5 Testing

- .1 Test sprinkler systems to NFPA listed requirements and furnish a certificate stating that such testing has been carried out and approved. Tests shall be witnessed by the authority having jurisdiction or his designated alternate.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Piping, valves and specialties serving building water distribution systems to 1m (36") outside the building.
- .2 Sanitary and storm drain waste and vent piping, equipment and accessories between plumbing fixtures to 1m (36") from the building.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts. For general conditions, refer to Section 23 05 02 Heating, Ventilation, and Air Conditioning.

1.3 Code Compliance

- .1 All work shall comply with current editions of the National, Provincial and Municipal Plumbing Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.

1.4 Cleanouts

- .1 Provide cleanouts on all sanitary and storm drainage piping at all changes in direction, at the ends of all horizontal runs, at the base of every stack, where drains leave the building; where shown on the drawings and in compliance with the local plumbing code, bylaws and ordinances.
- .2 Provide caulked or threaded type cleanouts extended to finished floor wall surface.
- .3 Provide bolted cover plate clean-outs on vertical rainwater leaders only. Ensure ample clearance at clean-out for rodding of drainage system.

2. PRODUCTS

2.1 Piping

- .1 Pipe Material
 - .1 Sanitary and Storm Drainage, and Vent (above grade).
 - .1 DWV Copper
 - .2 Cast Iron Class 4000
 - .3 PVC-15 Schedule 40
 - .4 PVC-15XFR Schedule 40.
 - .2 Sanitary and Storm Drainage and Vent (below grade inside building to 1m outside).
 - .1 Cast Iron Class 4000

- .2 PVC-DWV Schedule 40
- .3 ABS-DWV (Solid Core) Schedule 40.
- .3 Sanitary and Storm Drain (below grade outside service).
 - .1 Cast Iron Class 4000
 - .2 PVC SDR-35 to 12 NPS
- .4 Domestic Water (above grade inside building).
 - .1 Type "K" Hard Copper for hot and cold water
 - .2 Polypropylene (PP-R), SDR7.4 fusion weld pipe and fittings complying with 25/50 requirements of CAN/ULC S102.2
- .5 Domestic Water (below grade inside building to 1m outside).
 - .1 Type "K" Soft Copper to 4 NPS diameter
 - .2 PVC C900 DR18 from 4 NPS to 12 NPS (adapt to approved non-plastic material prior to penetration through the floor slab.
- .6 Domestic Water Service (below grade, outside service).
 - .1 Type "K" Soft Copper
- .7 Equipment drains and overflows:
 - .1 Steel Schedule 40, Galvanized, A120.

2.2 Valves

- .1 General:
 - .1 Wherever possible all valves shall be of one manufacturer.
 - .2 Grooved valves shall be of the same manufacturer as the adjoining couplings.
 - .3 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body. All valves must be suitable in all respects for service used.
 - .4 All valves shall have a Provincial CRN number, which is current.
 - .5 Use non-rising stem valves only where there is insufficient clearance for stem to rise.
- .2 Ball Valves 2 NPS and under
 - .1 Low lead forged brass body, 2 piece body, full port, chrome plated ball, PTFE seats, blow out proof stem, adjustable packing nut, for domestic water service.
 - .2 Class 4140 kPa (600 psi) W.O.G.
 - .1 Soldered: Toyo/Red & White 5544DAB or equal.
 - .2 Screwed: Toyo/Red & White 5549DAB or equal.

- .3 Check Valves 2 NPS and smaller:
 - .1 Lead free bronze swing check with bronze disc capable of being reground, Y pattern, suitable for domestic water use.
 - .2 Class 1380 kPa (200 psi) W.O.G.
 - .1 Soldered: Toyo/Red & White 237AB or equal.
 - .2 Screwed: Toyo/Red & White 236AB or equal.

2.3 Plumbing Piping Specialties

- .1 Vacuum Relief Valve: (for hot water tanks installations)
 - .1 ½ - 3/4 NPT, low profile, all brass construction, protective cap, tested to ANSI Z21.22, CSA certified, 860 kPa (125 psi) rating, maximum temperature 121°C (250°F).
- .2 Pressure Reducing Valve:
 - .1 1 NPS and smaller:
 - .1 Lead free copper silicon alloy body or low lead bronze body, SS integral strainer, renewable SS seat, serviceable inline, built in bypass check valve, suitable for hot and cold water potable water. Rated at maximum inlet pressure of 2100 kPa (305 psi) and 82°C (180°F) temperature.
 - .2 Pressure reducing pilot pressure 2100 kPa (30-200 psi)
- .3 Backflow Preventers Double Check Valve Assembly (DCVA)
 - .1 2 NPS and smaller, lead free cast copper silicone alloy body, twin positive seat check modules, captured springs, replaceable check module seats and discs, two isolation valves, test cocks and a bronze strainer. Comply with CSA B64.5 and AWWA C510
 - .1 Maximum working pressure: 1206 kPa (175 psi)
 - .2 Watts LF007 or equal
- .4 Strainers
 - .1 ¼ - 2 NPS threaded ends, bronze body, 1034 kPa (150 psi) rating.
 - .2 2½ NPS and larger, flanged ends, cast iron body, 860 kPa (125 psi) rating.
 - .3 With copper grooved end pipe systems use bronze body grooved end Y-strainer with stainless steel screen, 2068 kPa (300 psi) rating.

2.4 Preformed Pipe Insulation

- .1 Low to Intermediate Temperature, 5°C to 315°C (41°F to 599°F)
 - .1 Preformed insulation, fine fibrous glass or formed mineral fibre pipe insulation with all service jacket vapour retarder (ASJ). ASJ shall be re-enforced with glass fibre, factory applied with pressure sensitive lap closure. Maximum "K" value at 38°C (100°F) = 0.035 W/m.°C (0.24 Btu.in/hr.ft2.°F)
- .2 Finish Jackets

- .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.
- .2 PVC Finishing Jacket: white, UV resistant, for indoor or outdoor applications, 25/50 fire class, minimum 0.50 mm (0.02") thick.

2.5 Cleanouts

- .1 Floor - Unfinished Area: Cast iron floor level cleanout assembly with extra heavy duty, round, adjustable, scoriated, secured cast iron top and no-hub outlet. Suitable for heavy traffic
- .2 Floor - Finished Area:
 - .1 General areas: Cast iron cleanout with extra heavy duty round, adjustable, scoriated, secured nickel bronze top, and no-hub outlet
 - .2 Foot traffic areas with sheet goods flooring: Cast iron floor level cleanout assembly with a square adjustable nickel bronze top with 6mm (1/8") tile recess, and no-hub outlet.
 - .3 Carpeted floor area subject to foot traffic: Cast iron floor level cleanout assembly with round, adjustable, scoriated, nickel bronze top, and carpet clamping frame.
- .3 Wall – Finished Area:
 - .1 Concealed drainage line in a finished wall: Cast iron cleanout tee and cast iron countersunk plug with stainless steel round cover and screw.

2.6 Floor Drains

- .1 Provide trap seal priming connections on all drains
- .2 Finished Area Drains
 - .1 Floor Drain "FD1" (washroom, shower)
 - .1 Heavy duty polished nickel bronze round strainer, 125mm (5") diameter

2.7 Trap Seal Primers

- .1 Provide flow actuated type priming device, vacuum breaker ports and internal back-flow protection, lead free brass body, stainless steel screen, factory pre-set, activation by a minimum flow rate of 0.03l/s @ 138 kPa (0.5 GPM @ 20 psi). 1/2 NPS inlet and outlet, capable of serving 1 to 4 traps.
 - .1 Provide 1/2 NPT globe valve upstream of the solenoid valve for throttling.
 - .2 Provide a relay and building automation system interface. Coordinate with Division 25 to provide the DDC connection and an adjustable schedule such that the valve is actuated for 3 minutes (adjustable) once a week.
- .2 Coordinate with Division 26 for solenoid power requirements and location.

2.8 Roof Drains:

- .1 Basic characteristics for all drains unless noted otherwise:
 - .1 Flow Characteristics: Full open flow unless noted otherwise.
 - .2 Material: Cast iron body and components, coated for weather protection.
 - .3 Bolts shall be galvanized.
 - .4 Dome: Aluminum, vandal proof secured fastenings.
 - .5 All drains to include membrane flashing clamp, V-notched gravel guard and under deck clamping.
 - .6 Bosses: solid, integrally cast, for under deck clamping ring and flashing flange bolts.
 - .7 Discharge: 3 NPS plain end mechanical joint.
- .2 Roof Drain 'RD1': (medium area drain) Menzies Commercial Spun Copper Insert Drain or equivalent.
 - .1 225mm (9") Commercial spun copper roof drain, 450mm (18") diameter flange.
 - .2 Two-piece membrane clamping system
 - .3 Cast aluminum high-rise dome, vandal resistant fastenings
 - .4 Extension pipe length 300mm (12").

2.9 Safes, Flashing and Vent Terminals

- .1 Metal Flashing: 26 gage galvanized steel.
- .2 Metal Counter flashing: 22 gage galvanized steel.
- .3 Lead Flashing: Waterproofing: 5 lb/sq ft sheet lead.
- .4 Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- .5 Floor Drain Flashing: 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy.
- .6 Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.10 Expansion Tanks – Domestic Hot Water

- .1 Diaphragm or bladder type expansion tank, welded steel tank, internal butyl/EPDM diaphragm or butyl bladder, rigid polypropylene liner. Integral floor stand for vertical installation. Listed for potable water systems.
- .2 ASME rated for a working pressure of 861 kPa (125psi)
- .3 Amtrol Therm-x-trol model ST-5 or equal

2.11 Plumbing Fixtures

- .1 Water Closet (WC1) – Floor Mounted

- .1 Bowl: Floor mount Flush Meter valve toilet meets definition for HET, colour white, vitreous china, 4.8 L (1.07 US Gal) (Will also function at 3.8l (0.8US GAL))per flush 305 mm (12") rough-in, elongated bowl, Flush Valve –, 1.2GPF, exposed, battery powered sensor operated. Vandal resistant cap. C/W Fully mechanical manual override button.
 - .1 American Standard MADERA FLOWISE 350MM HEIGHT or equal.
 - .2 Flush Valve: American Standard Selectronic Flowise Flush Valve(Model 6065.121.002).
- .2 Seat: Heavy duty toilet seat, elongated bowl, white solid plastic, open front less cover, stainless steel check hinges, stainless steel posts and nuts.
 - .1 Bemis #1955SSC White or equal
- .2 Lavatory (L1) – Wall Hung (Accessible)
 - .1 Basin: Wall hung vitreous china, white, front overflow, faucet ledge.
 - .1 Bradley Terreon Imperial Wall Mount (TL-18) or equal.
 - .2 Trim: Electronic faucet with proximity operation, DC Battery power operated, vandal resistenat cast brass body with single inlet, check valve and filter screen. Single post mounting. Features integrated design with the sensor, Solinoid valve and electrocnics enclosed in the spout.
 - .1 American Standard #705--1-5 or equal
 - .3 Point Of Use Mechanical Water Mixing Valve, bronze body, temp. adjustment, 10 mm (3/8") connections, thermostatic limit stop, shut-off with automatic reset when temperature exceeds 48.8 °C (120 °F), integral checks.
 - .1 American Standard #605XTMV1070
 - .4 Offset Open Grid Drain, cast brass one piece top, tubular 32 mm (1 1/4") tailpiece.
 - .5 Sanitary Trap Covering vandal-resistant, flexible seamless moulded closed-cell PVC resin, anti-microbial. (To protect against heat/contusions).
 - .1 McGuire PROWRAP #PW2000WC or equal.
 - .6 Basin Carrier: concealed arms, wall flanges to attach to backing plate, heavy gauge steel uprights with integral welded feet, levelling screws, locking device and plated hardware.
 - .1 Watts #WCA-411-WC or equal
- .3 Sink (S1) – Single Bowl Stainless Steel
 - .1 Basin: Counter mount sink, 1 hole, 508 mm (20") wide x 521 mm (20½") x 203 mm (8") deep, backledge, grade 18-10 20 GA. (0.9 mm) type 302 stainless steel, satin finish, undercoated, rim seal, 89 mm crumb cup waste assembly with 38 mm tailpiece.
 - .1 Franke Commercial #LBS6808-1/1 or equal

- .2 Trim: Single Lever faucet, lead free chrome plated cast brass body, 5.7 LPM (1.5 GPM) aerator, 229 mm (9") long cast spout, lever handle, adjustable limit stop
 - .1 Chicago Faucets #430-ABCP or equal.
- .4 Exterior Hose Bib (HB-1)Watts #HY-330
 - .1 Moderate climate wall hydrant with NB box, integral vacuum breaker, all bronze head, seat casting and internal working parts, wall mount hydrant, 6-7/16" x 5-7/16" (164 mm x 138 mm), chrome plated face, nickel bronze box and door, loose key, 3/4"Ø (19 mm) hose connection, 3/4"Ø (19 mm) female x 1"Ø (25 mm) male pipe connection.
- .5 Roof Deck Hose Bib (HB-2)JR Smith 5907
 - .1 Non-Freeze Roof Hydrant with Check Valve, Galvanized Casing and Adjustable Flow Wheel Lock Handle with Deck Flange and Under Deck Clamp., and 1/8" NPT drain port., 3/4"Ø (19 mm) hose connection 3/4"Ø (19 mm) pipe connection

3. EXECUTION

3.1 Piping

- .1 Water pipe connections unless noted otherwise:
 - .1 1½ NPS and less: soldered or screwed joint
 - .2 2 NPS: Screwed joint for liquid systems.
 - .3 2½ NPS and larger: Weld or flanged piping including branch connections.
 - .4 Inside building - screw or weld 2 NPS and under. Weld 2½ NPS and over.
- .2 Use dielectric type couplings when joining dissimilar metal pipes.
- .3 Use lead free solder for soldering domestic water copper pipe.
- .4 Pipe Hangers and Supports
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction, and accommodate insulation.
 - .2 Natatorium: All hangers and supports shall be hot dipped galvanized and painted in place in the Natatorium.
 - .3 Provide galvanized hangers and supports for all piping except hangers and supports shall be copper plated or epoxy coated for copper piping.
 - .4 Use of perforated straps is not permitted for pipe hangers.
 - .5 Power actuated fasteners and "drop-in" anchors shall not be used.
 - .6 Provide ring type hangers for piping up to NPS 1½ and clevis type hangers for piping over NPS 1½.

3.2 Pipe Support Spacing

Material	Maximum Pipe Size NPS	Minimum Rod Diameter mm (in)	Maximum Rod Length mm (in)	Maximum Spacing m (ft)
Copper And Steel	up to 3/4	9 (3/8)	n/a	1.5 (5)
	1	9 (3/8)	n/a	1.85 (6)
	1 1/4	9 (3/8)	n/a	2.15 (7)
	1 1/2 to 2	9 (3/8)	n/a	2.5 (8)
	2-1/2 to 3	12 (1/2)	635 (25)	2.75 (9)
	4 to 5	16 (5/8)	785 (31)	3.7 (12)
Steel	6	20 (3/4)	940 (37)	5.2 (17)
Steel	8 to 12	22 (7/8)	1090 (43)	5.8 (19)

- .1 Plastic or glass pipe
 - .1 Refer to manufacturers recommendations for maximum spacing requirements.
 - .2 Utilize the minimum rod diameter and maximum rod length for the corresponding pipe size of steel pipe.
- .2 For rod lengths in excess of the tabulated maximum rod length, reinforcing is required per SMACNA Seismic Restraint Manual or the Seismic Engineers written instruction.
- .3 Expansion Compensation
 - .1 Provide structural work and equipment required for expansion and contraction of all piping. Provide anchors, guides, and expansion joints as required to adequately protect the piping systems.
 - .2 Provide expansion compensation for all closed piping systems including but not limited to: heating water, chilled water, steam and condensate, closed condenser water systems, and all other closed piping systems that operate at varying temperatures. Expansion compensation may be eliminated from open systems such as domestic cold, domestic hot, domestic hot recirculating systems except where located in vertical service shafts.
 - .3 All piping shall be anchored and supported in such a manner that strain and/or weight does not come upon any apparatus and pipe branch connections. Expansion joints and compensators shall be installed and guided as per manufacturer's recommendations. All equipment shall be connected with unions or flanges to provide for easy removal. Where piping passes through walls or floor slabs, the sleeves shall be of sufficient size to accommodate the expansion and the pipe insulation, without binding or crushing the insulation or preventing the expansion of the piping.

3.3 Valves

- .1 Install all valves in accordance with manufacturer's recommendations.

- .2 Install valves in accessible locations with stems upright or angled 45° above horizontal unless approved otherwise. Valves must be accessible without removing adjacent piping.
- .3 Install control valves with their stems upright unless approved otherwise and with adequate clearance for removal of actuators.
- .4 Provide stem extensions on all insulated valves.
- .5 Provide full port ball valves in piping 50 mm (2") and smaller and butterfly valves in piping 65 mm (2½") and larger for shut-off, equipment isolation, throttling, bypass or manual flow control services.
- .6 Throttling valves are not to be used for shut-off; additional valves shall be installed for isolation purposes.
- .7 Provide isolation valves at branch take-offs, to isolate each piece of equipment, upstream of all meters, gauges, automatic air vents, and as indicated.

3.4 Piping Insulation Minimum Thickness Schedule

Type of System	Design Operating Temperature Range °C (°F)	Thermal Conductivity of Insulation		Nominal Pipe Diameter (NPS)				
		Conductivity Range W/m.°C	Mean Rating Temperature °C (°F)	Runouts ≤ 1	≤ 1	1-1/4 to 2	2-1/2 to 4	≥ 5
				Minimum Thickness of Piping Insulation (mm)				
Above Grade Exterior	All	0.046-0.049	38 (100)	40	65	65	75	90
Hot Water Systems	61-93 (142-200)	0.036-0.042	52 (126)	25	40	50	50	50
	41-60 (106-141)	0.035-0.040	38 (100)	25	25	40	40	40
Cold Water & Refrig.	5-16 (41-61)	0.030-0.039	24 (75)	25	25	25	25	25
	<5 (41)	0.030-0.039	24 (75)	25	25	40	40	40

Note: Where the thermal conductivity of a proposed insulation is greater than the range specified above, the thickness will be increased by the ratio of U2/U1.

U2 = proposed insulation "k" value at the table mean rating temperature.

U1 = upper range limit "k" value from the table above.

Note: Where thermal conductivity of proposed insulation is less than the range specified above, the thickness may be decreased by the ratio of U2/U1.

U2 = proposed insulation "k" value at the table mean rating temperature.

U1 = lower range limit "k" value from the table above.

3.5 Piping Finish Schedule

- .1 Indoors concealed; factory finish
- .2 Indoors exposed in mechanical room and elsewhere; canvas jacket

- .3 Indoors, exposed in utility areas, parkade, etc.; PVC jacket

3.6 Safes, Flashing and Vent Terminals

- .1 Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls and floors.
- .2 CPE, Chloraloy 240 lining or lead material may be used at floor drains and cleanouts. Chloraloy shall be solvent welded to manufacturer's installation instructions. Lead shall not be used on roofs where the roofing material is applied by a torch-on method.
- .3 Flash floor drains in floors with topping over occupied areas with lead or CPE membrane, a minimum of 300mm (12") clear on sides with minimum 900mm x 900mm (36" x 36") sheet size. Fasten flashing to drain clamp device.

END OF SECTION

1. GENERAL

1.1 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 General Scope

- .1 'Provide' shall mean 'supply and install'.
- .2 'Consultant' shall mean AME Group Consulting Professional Engineers
- .3 Provide complete, fully tested, and operational systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .4 Contract documents and drawings of this Division are diagrammatic and approximately, to scale unless detailed otherwise. They establish scope, material, and installation quality but are not detailed installation instructions.
- .5 Follow manufacturers' recommended installation instructions, details, and procedures for equipment, supplemented by requirements of the Contract Documents.
- .6 Before submitting tender, visit and examine the site and note all characteristics and features affecting the work. No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing thereon, which is visible or known to exist at the time of tender.
- .7 Clarifications or requests for alternate materials or equipment must be submitted in writing to the Consultant no later than seven (7) working days prior to the Mechanical trades' closing tender date. Approval of requests shall only be given by addendum.
- .8 Make reference to electrical, mechanical, structural, and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

1.3 Code Compliance, Permits and Fees

- .1 All work shall comply with current editions of the National, Provincial and Municipal Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the scope of work. Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

1.4 Tender Price Breakdown

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Consultant. As a minimum, include the following in the tender price breakdown:
 - .1 Mechanical: Equipment, materials, labour
 - .2 Plumbing: Equipment, materials, labour
 - .3 Sheet Metal: Equipment, materials, labour
 - .4 Controls: Equipment, materials, labour

1.5 Submittals

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures and in addition the following:
- .2 Contractor shall provide and submit to the Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
- .3 Shop drawings: Submit shop drawings for all equipment as electronic files (file format: .dwg, .dxf, pdf, or comparable). When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include a complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data
- .4 Closeout Submittals: Provide a minimum of four (4) mechanical operation and maintenance manuals and one digital copy, prepared by the Mechanical Contractor.
 - .1 Operation and maintenance manual approved by, and final copies deposited with the Consultant a minimum of 7-days before final inspection.
 - .2 Operation and maintenance manual to include but not limited to:
 - .1 Layman's description of the systems and associated controls.
 - .2 Operational instructions, servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - .3 Warranties
 - .4 Equipment manufacturer's performance datasheets indicating point of operation as left after commissioning is complete.
 - .5 Testing, adjusting, and balancing reports.
 - .6 List of suppliers and contact information.
- .5 Record Drawings:

- .1 Consultant will provide 1 set of white prints at contractors cost to mark changes as work progresses and as changes occur. Use different colour waterproof ink for each service. Do not use pencil or black ink. Transfer information weekly to show work as actually installed. Drawings shall be available on a weekly basis for review by the Consultant.
- .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- .3 Submit to Consultant for approval and make corrections as directed.
- .4 Submit completed CAD record drawings with final Operating and Maintenance Manuals within two (2) weeks of substantial completion. Failure to submit drawings will result in the work being undertaken by the Owner and deducted from the Contractor's hold back amount.
- .5 Cost to transfer record information onto reproducible media & Auto-CAD disks are this contractor's responsibility. Consultant will release drawings to contractor after signing a copyright form. Should the Contractor choose to utilise this consultant for transferring as built information, allow \$400 / sheet for all drawings in the construction set. This will cover costs for drafting time & printing costs.

1.6 Quality of Work

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Consultant. Work, which does not conform to standards accepted by the Consultant and the trade, may be rejected by the Consultant. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.7 Metric Conversion

- .1 All units in this division are expressed in SI units.
- .2 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .3 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.
 - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

Equivalent Nominal Diameter of Pipes					
mm	Inches (NPS)	mm	Inches (NPS)	mm	Inches (NPS)

3	1/8	40	1-1/2	200	8
6	1/4	50	2	250	10
10	3/8	65	2-1/2	300	12
15	1/2	75	3	375	15
20	3/4	100	4	450	18
25	1	125	5	500	20
30	1-1/4	150	6	600	24

.4 Metric Duct Sizes:

- .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.8 Drawings and Specifications

- .1 Should any discrepancy appear between drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, obtain written clarification from the Consultant during the tender period. Without a written clarification, the better quality and/or greater quantity of work or materials shall be estimated, performed, and furnished within the tendered price.
- .2 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out and equipment will fit within the proposed locations without changes to building.

1.9 Cutting, Patching and Coring

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves. All work shall be coordinated with other trades.
- .2 Obtain written approval from the Structural Consultant before cutting or burning structural members.
- .3 Provide X-ray of all required penetrations of the floor. X-ray use for locating in floor rebar and conduit to be done after normal working hours. Take necessary precautions to protect computer equipment when X-raying floors. Coordinate with Owner.

1.10 Compliance with Energy By-Law

- .1 All equipment installed on this project shall comply with:
- .1 National Energy Code of Canada for Buildings - 2015
- .2 ASHRAE Standard 90.1 - 2016

1.11 Installation of Equipment

- .1 Pipe all equipment drains to building drains except systems containing glycol.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.

- .3 Maintain permanent access to equipment for maintenance.

1.12 Connections to Existing Services

- .1 Maintain liaison with the Owner and provide a mutually acceptable schedule to interrupt, reroute, or connect to existing building services with the minimum of interruption of those services.

1.13 Selective Demolition

- .1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
- .3 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Owner at his discretion. All material not taken over by the Owner or removed from the building under this contract shall be removed from this site and disposed of as required by any applicable disposal regulations.
- .4 Turnover to and deliver to the Owner's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.14 Equipment and Materials

- .1 Refer to the attached List of Acceptable Manufacturers.
- .2 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .3 Notify the Consultant in writing ten (10) days prior to the tender close, any materials or equipment specified which is not currently available or will not be available for use as called for herein. Failing this, the contract will assume that the most expensive alternate has been included in the tender price.
- .4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .5 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.
- .6 The Owner and/or Consultant holds the right to reject any equipment and/or materials that is different from that specified. It is the Contractor's responsibility to replace with the acceptable material or equipment as required.
- .7 All equipment installed on this project shall comply with all applicable requirements including:
 - .1 CSA Standards

- .2 Local Standards and Bylaws
- .3 Manufacturer requirements and recommendations
- .4 National Building Code and all referenced codes and standards
- .5 National Fire Code
- .6 National Plumbing Code
- .7 NFPA standards
- .8 National Energy Code of Canada for Buildings (NECB)
- .9 ASHRAE Standard 90.1
- .10 ASHRAE Standards, Guidelines, Handbooks and Design Guides

1.15 Delivery, Storage and Handling

- .1 Storage and Handling Requirements:
 - .1 Store materials and equipment in accordance with the manufacturer's recommendations; in a clean, dry, well-ventilated area. Coordinate location of storage with the Owner.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .2 Protect equipment and open end duct with polyethylene covers and maintain equipment on crates until installation.
- .3 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.16 Firestopping and Smoke Seals

- .1 Provide firestopping system(s) to provide and maintain a fire resistance rating, as indicated on drawings and in accordance with UL, WH, ULC, cUL or FM design details for all mechanical work in Divisions 21, 22, 23 and 25.
- .2 For renovation projects, in addition to the necessary new penetrations, provide the firestopping for all existing mechanical assemblies where firestopping is damaged, discontinued or absent.
- .3 All firestop system installations must meet the requirements of CAN4-S115-M or ULC S-115-M Tested assemblies that provide a fire rating.
- .4 A manufacturer's direct representative (not distributor or agent) shall be on-site during the initial installation of firestop systems to train appropriate contractor personnel in correct selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

1.17 Access Doors

- .1 Provide access doors for maintenance or adjustment of all parts of the mechanical system.

- .2 Provide 300 mm x 300 mm minimum size for inspection and hand access.
- .3 600 mm x 600 mm minimum size, larger if indicated on drawings, where entry is required and access is difficult.

1.18 Escutcheons and Plates

- .1 Provide escutcheons and plates on all piping and ductwork passing through finished walls, floors, and ceilings.

1.19 Guarantee / Warranty

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance.

1.20 Balancing

- .1 The approved balancing agencies are: Blue Collar Group, Flotech Mechanical, Western Mechanical; K.D. Engineering.
- .2 Balance terminal boxes, exhaust fans and air outlets to air quantities indicated on the drawings and in this specification. Where outlet quantities are not indicated, divide box capacity equally among all outlets.
- .3 The balancer shall use appropriate air flow settings and control methods for single floor systems, accounting for the central system air volume diversity.
- .4 Submit a PDF copy of the report to the Consultant within two (2) weeks after substantial completion. Failure to submit the report within the specified time will result in the work being done by the Owner and the costs deducted from final payment.
- .5 Balancing shall be performed to the following:
 - .1 Air-Terminal Outlets: $\pm 10\%$
 - .2 Air-Central Equipment: $\pm 5\%$
 - .3 Hydronic-Pumps and Central Equipment: $\pm 5\%$
- .6 Cooperate with the Balancing Agency as follows:
 - .1 Make any corrections as required by Balancing Agency.
 - .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings and specifications for their use.
 - .3 Operate automatic control system and verify set points during balancing.
 - .4 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.

- .5 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to Owner.
- .6 Allow in the contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

1.21 System Cleaning and Chemical Treatment

- .1 Disinfect and flush all domestic cold, hot and recirculation water systems, provide a certificate for this work.

1.22 Flashing and Roof Curbs

- .1 Provide curbs, flash and counter flash as required where mechanical equipment passes through weather or waterproofed walls, floors and roofs.
- .2 Provide factory roof curbs for all roof mounted equipment unless noted otherwise.

1.23 Seismic Control

- .1 Provide seismic restraints for all required equipment, piping, and ductwork.
- .2 The Contractor shall retain the services of a qualified professional seismic engineer (Seismic Engineer) registered in the Province of British Columbia. The Seismic Engineer shall design and review the installation of all seismic restraints as well as mechanical equipment and mechanical system supports. The restraints and supports shall be specifically designed to fasten to the structure indicated in the contract documents and installed in the field. The complete design for these systems shall comply with all applicable building code requirements.
- .3 Seismic Engineer shall provide and submit to the Owner's Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
- .4 Piping ductwork and equipment shall be restrained in accordance with the latest edition of the Seismic Restraints Manual for Mechanical Systems produced by SMACNA, and the latest edition of the ASHRAE Application Handbook Chapter 49, Seismic Restraints.
- .5 Submit shop drawings of all seismic restraint details prepared and sealed by the seismic engineer. Prior to substantial completion, the seismic engineer shall visit the site and verify the seismic restraint installation as required to satisfy the Assurance of Professional Field Review and Compliance Schedule C-B C-2 of the Building Code.
- .6 The contractor shall obtain approval for the location of all restraint fixing points from the structural engineer, on site, prior to installation.

- .7 Where equipment is mounted on spring or resilient mounts for vibration isolation, it shall be the responsibility of the manufacturer of the mount to incorporate seismic restraint. These restraints shall be multi-directional as described in the guidelines specified above. Provide steel frame bases where necessary to achieve this and also avoid overturning. The manufacturer shall supply certificates, signed by a Professional Engineer registered within the jurisdiction, verifying the design of the seismic restraints in accordance with this section.

1.24 Vibration Isolation

- .1 Provide neoprene isolators for deflections 6mm ($\frac{1}{4}$ ") and under.
- .2 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm ($\frac{1}{2}$ ").
- .3 Provide steel spring isolators for deflections of 12mm ($\frac{1}{2}$ ") and over.
- .4 Provide adjustable limit stops for spring isolation mounts on equipment with operating weights substantially different from the installed weights
- .5 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed spring isolators may be used in lieu provided that they meet this project's requirements for seismic restraint.
- .6 Select isolators in accordance with equipment weight distribution to allow for an average deflection meeting or exceeding the specified deflection requirements and so that no isolator has a deflection less than 80% of the static deflection specified. A minimum of 4 isolators are required for each piece of equipment, unless specified otherwise. Refer to the minimum static deflection table contained in this Section.

1.25 Substantial and Total Performance

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items, which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed and available to the Owner's Consultant:
 - .1 Final Plumbing Inspection Certificate from the Authority having Jurisdiction.
 - .2 Schedule C-2 C-B for seismic engineering.
 - .3 Final Backflow Prevention test reports for all backflow devices.
 - .4 Draft Operating/Maintenance Manuals have been submitted for review.
 - .5 All mechanical systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.
 - .6 Air and water systems have been balanced with draft report submitted to the Consultant.
 - .7 Operating and Maintenance demonstrations have been provided to the Owner.
 - .8 Record drawings have been submitted.

- .9 All previously identified deficiencies have been corrected and accepted.
- .3 Prior to a Total Performance Inspection, provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
 - .1 Submit final air and water balance reports.
 - .2 Submit final operating and maintenance manuals.
- .4 The Consultant shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required shall be at the expense of the Contractor.

1.26 Materials and Equipment

- .1 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .2 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.
- .3 All rotating equipment shall be supplied from the manufacturer with dynamically balanced shafts, wheels and any other rotating parts. Equipment supplier and manufacturer are responsible for any additional balancing, equipment, and materials replacement, and cost for addressing damages to the building, any systems, and equipment due to the supplied equipment improper balancing.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.
- .2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
- .3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers listed.

2.2 Electrical Motors

- .1 Supply mechanical equipment complete with electrical motors.

- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable frequency drive (VFD) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 3/4 hp shall be 120 V, 60 Hz, 1 phase. Motors 3/4 hp and larger shall be 3 phase at the indicated voltage.
- .6 Provide motors complete with equipment except where indicated.
- .7 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .8 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .9 Refer to electrical specifications, for voltage, frequency, and phase data. This shall take precedence over any reference in mechanical specification.
- .10 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .11 Minimum certified motor efficiency shall be as outlined in ASHRAE 90.1.

2.3 Ductwork and Accessories

- .1 Provide ductwork constructed, reinforced, sealed, and installed to withstand 1-1/2 times the working static pressure.
- .2 Low Pressure Ductwork 500 Pa (2" W.G.) and under
 - .1 Supply ductwork and plenums on systems without terminal mixing boxes or air valves.
 - .2 Supply ductwork downstream from terminal mixing boxes or air valves.
 - .3 Outdoor air ductwork and plenums, unless noted otherwise.
 - .4 Return air ductwork and plenums, unless noted otherwise.
 - .5 Exhaust and relief air ductwork and plenums, unless noted otherwise.
 - .6 Low pressure insulated flexible ductwork shall be equal to Thermaflex Type M-KC.
 - .7 Connect outlet terminals to low pressure ducts with 900mm (36") maximum length of stretched flexible duct. Hold in place with strap or clamp, caulk sealed. Do not use flexible duct to change directions.

- .8 Provide a flexible connection where low pressure ducts are connected to fan equipment, terminal boxes, or any other apparatus. Joint shall be screwed or bolted flexible gasketed joint, minimum 50mm (2") wide.
- .3 Duct Hangers
 - .1 Hangers and Supports to SMACNA standards
 - .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .3 Maximum size duct supported by strap hanger: 500 mm.
 - .4 Hangers: Galvanized steel angle with galvanized steel rods to SMACNA.
 - .5 Toggle hangers and/or strap hangers shall not be used.
 - .6 Power actuated fasteners and "drop-in" anchors shall not be used for tension load applications such as pipe and duct hangers.
- .4 Duct Sealing
 - .1 Low Pressure Ductwork 500 Pa (2" W.G.) and under shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (1/16") use heavy mastic type sealant.
 - .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - .3 Other Joints: Heavy mastic type sealant.
 - .2 Medium Pressure Ductwork to 1000 Pa (4"W.G.) shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - .1 Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.
 - .3 Duct tapes as sealing method are not permitted, except on residential ductwork – minimum 2 wraps of 2" wide (50mm) foil duct tape is acceptable.
 - .4 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
 - .5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application, by the Consultant.

2.4 Access Doors

- .1 Drywall Surface: Extruded aluminum frame with gypsum board inlay and structural corner elements. Hinge to be concealed 2-point hinge, non-corroding with allen head cam latch.

2.5 Identification

- .1 Identify piping with labels and flow arrows. Provide identification at 15m (50ft) maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors. Use Brady B-500 vinyl cloth labels for non insulated pipes and B-350 for insulated pipes.
- .2 Provide 20mm ($\frac{3}{4}$ ") diameter brass tags, secure to valve stems with key chain. Provide a valve directory at all mechanical rooms, in the O&M manuals and a digital copy cross referenced with any associated controls nomenclature.
- .3 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan SF-1, cooling coil CC-1, pump P-1 with lamacoid plates having 6mm ($\frac{1}{4}$ ") minimum letter size.

2.6 Piping

- .1 Pipe Material
 - .1 Refrigerant:
 - .1 ACR Copper.
- .2 Pipe Connections
 - .1 Unless noted otherwise:
 - .1 NPS $1\frac{1}{2}$ and less: screwed joint steel piping
 - .2 NPS 2: screwed joint for liquid systems, weld joint for air or gas systems.
 - .3 NPS $2\frac{1}{2}$ and larger: Weld or flanged piping including branch connections.
 - .2 Use dielectric type couplings when joining dissimilar metal pipes.
 - .3 Use lead free solder for soldering domestic water copper pipe.
 - .4 Grooved mechanical couplings are not acceptable.
 - .5 Press-fit type couplings are not acceptable.

2.7 Valves

- .1 General:
 - .1 Wherever possible all valves shall be of one manufacturer.
 - .2 Grooved valves shall be of the same manufacturer as the adjoining couplings.
 - .3 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body. All valves must be suitable in all respects for service used.
 - .4 All valves shall have a Provincial CRN number which is current.
 - .5 Use non-rising stem valves only where there is insufficient clearance for stem to rise.

- .6 Butterfly valves may only be used on heating water systems or heat recovery systems where the maximum design temperature does not exceed 82°C (180°F).
- .2 Ball Valves 2 NPS and under
 - .1 Forged brass body, threaded cap, chrome plated ball, PTFE seats, blow out proof stem, adjustable packing nut.
 - .2 Ball valves for isolation service shall have a large/full port.
 - .3 Ball valves for balancing service shall have a reduced port and valve handle shall have a memory stop.
 - .4 Screwed: Class 4140 kPa (600 psi) W.O.G.
 - .1 Toyo/Red & White 5044AB or equal.
- .3 Gate Valves 2 NPS and under:
 - .1 Bronze body, rising stem, solid wedge disc, union or screwed bonnet.
 - .2 Screwed: Class 2070 kPa (300 psi) W.O.G.
 - .1 Toyo/Red & White 298 or equal.
- .4 Check Valves 2 NPS and smaller:
 - .1 Bronze swing check with bronze disc capable of being reground
 - .2 Screwed: Class 13880 kPa (300 psi) W.O.G.
 - .1 Toyo/Red & White 238 or equal.

2.8 Duct and Breeching Insulation

- .1 Round Ducts and Concealed Rectangular Ducts: External flexible insulation, service temperature 5°C to 232°C (41°F to 450°F), glass fiber or mineral fiber flexible blanket for low and medium temperature applications, all service aluminum foil-scrim kraft (FSK) vapour barrier jacket with glass fibre reinforcement, factory applied.
 - .1 Density 12kg/m³ (0.75PCF), Minimum RSI 0.49/25mm (R 2.8/in) (installed)
- .2 Acoustic Lining Ducts: Internal flexible duct liner, flexible mineral fiber blanket, for low and medium temperature acoustical applications, airstream surface faced with a black mat bonded to the fibreglass substrate, air velocity rating 25.4 m/s (5,000 ft/min)
 - .1 Density 24kg/m³ (1.5 PCF), Minimum RSI 0.74/25mm (R 4.2/in)
- .3 Acoustic Lining Ducts: Black flexible closed-cell elastomeric thermal and acoustical duct insulation, service temperature -40°C (-40°F) up to 93°C (200°F), ASTM E 84, NFPA 255, UL723
 - .1 Density 48kg/m³ (3 PCF), Minimum 25.4mm (1"), Minimum RSI 0.74/25mm (R-4.2)

- .4 Acoustic Lining Plenums: Internal rigid duct liner, rigid mineral fiber board, for low and medium temperature acoustical applications, airstream surface faced with a black mat bonded to the fibreglass substrate, air velocity rating 25.4 m/s (5,000 ft/min)
 - .1 Density 48kg/m³ (3 PCF), Minimum RSI 0.76/25mm (R 4.3/in)
- .5 Breeching Insulation: External semi-rigid insulation, service temperature up to 538°C (1000°F), glass fiber or mineral fiber flexible blanket for high temperature applications.
 - .1 Density 25kg/m³ (1.6PCF), Minimum RSI 0.25/25mm (R 1.4/in)
- .6 Finish Jackets
 - .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.
 - .2 Utility Finish: Over rigid insulation for rectangular ductwork and flexible insulation for round ductwork. Apply continuous metal corner bead to all corners. Adhere vapor retarder tape over all joints and breaks in vapor retarder, and at all corners.

2.9 Preformed Pipe Insulation

- .1 Low to Intermediate Temperature, 5°C to 315°C (41°F to 599°F)
 - .1 Preformed insulation, fine fibrous glass or formed mineral fibre pipe insulation with all service jacket vapour retarder (ASJ). ASJ shall be re-enforced with glass fibre, factory applied with pressure sensitive lap closure. Maximum "K" value at 38°C (100°F) = 0.035 W/m.°C (0.24 Btu.in/hr.ft².°F)
- .2 Finish Jackets
 - .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.
 - .2 PVC Finishing Jacket: white, UV resistant, for indoor or outdoor applications, 25/50 fire class, minimum 0.50 mm (0.02") thick.
 - .3 Aluminum Jacket: 0.51 mm (22 ga.) thick stucco or smooth aluminum jacketing with longitudinal slip joints and 50mm (2") end laps with factory applied protective liner on interior surface.

2.10 Equipment Insulation

- .1 Low to Intermediate Temperature, 5°C to 315°C (41°F to 599°F)
 - .1 Fine fibrous glass or mineral fibre insulation. Maximum "K" value at 38°C (100°F) = 0.035 W/m.°C (0.24 Btu.in/hr.ft².°F)

2.11 Seismic Cable Restraints

- .1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.

- .2 Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.

2.12 Vibration Isolation

- .1 Neoprene Washer/Bushing
 - .1 A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact. Use washer/bushing only on light-weight equipment.
 - .1 Mason HG hemi grommet or equal
- .2 Neoprene Pad Isolators
 - .1 Neoprene or neoprene / steel / neoprene pad isolators. Minimum static deflection 2.5 mm (0.1") or greater.
 - .1 Mason WMSW or equal
- .3 Rubber Floor Mounts
 - .1 Bridge bearing neoprene mountings. Minimum static deflection of 5mm (0.2") or greater and all directional seismic capability.
 - .1 Mason RAA or ND or equal
- .4 Spring Hangers
 - .1 Hangers shall consist of rigid steel frames containing minimum 32mm (1 1/4") thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom.
 - .2 Provide a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, and equipment. Rubber thickness shall be a minimum of 6mm (1/4"). Colour coded springs, rust resistant, painted box type hangers.
 - .3 To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
 - .1 Mason HD, HS or equal
- .5 Acceptable Manufacturers, Korfund, Vibro-Acoustics

3. EXECUTION

3.1 Painting Repairs and Restoration

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

- .4 Clean exposed bare metal surfaces supplied under Divisions 21, 22, 23 and 25. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

3.2 Demonstration

- .1 Supply tools, equipment, personnel to demonstrate and instruct the operating, and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.

3.3 Ductwork and Accessories

- .1 Fabricate ductwork in accordance with:
 - .1 SMACNA Duct Construction Standards – metal and flexible
 - .2 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
 - .3 NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - .4 NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 Prior to fabrication of ductwork, check all ceiling spaces and heights and conflicts with other trades.
- .3 Duct sizes indicated are inside clear dimensions. For acoustically lined or internally insulated ducts allow for insulation thickness and maintain interior clear dimensions indicated.
- .4 Provide fire dampers where ducts cross fire separations. Fire dampers shall be ULC listed and “dynamic”; rated to close under airflow. Refer to architectural drawings for fire separation ratings and locations.
- .5 Provide balancing dampers where indicated on drawings and at points on low pressure supply, return and exhaust ducts where branches are taken from larger ducts.
- .6 Provide return air openings and/or insulated sound traps where indicated.
- .7 Provide acoustical seal around ducts and sound traps at penetration through sound baffles.
- .8 Modify ceiling system where required to accommodate grilles and diffusers.
- .9 Size round ducts, installed in place of rectangular ducts, from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by permission from the Consultant.
- .10 Exposed round ductwork to be spiral lock seam type only.
- .11 Provide duct hangers and supports in accordance with SMACNA manuals.

- .12 Confirm the existing base building standards prior to submitting tender.
- .13 Ductwork shall be galvanized steel unless noted otherwise.
- .14 Duct support shall be:
 - .1 Up to 750mm duct size: angle size 25x25x3 mm with 6mm rod size
- .15 Upper hanger attachments shall be:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps.

3.4 Access Doors

- .1 Provide all access doors required to access work installed by Divisions 21, 22, 23 and 25. Be responsible for coordinating locations, cutting opening and installing panels. Any secondary supports, blocking etc. will be by the ceiling or wall contractor.
- .2 Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

3.5 Piping

- .1 Pipe Hangers and Supports
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction, and accommodate insulation.
 - .2 Provide galvanized hangers and supports for all piping except hangers and supports shall be copper plated or epoxy coated for copper piping.
 - .3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
 - .4 Toggle hangers and/or perforated strap hangers shall not be used for pipe hangers.
 - .5 Power actuated fasteners and “drop-in” anchors shall not be used for tension load applications such as pipe hangers.
 - .6 Provide ring type hangers for piping up to NPS 1½ and clevis type hangers for piping over NPS 1½.

3.6 Pipe Support Spacing

Material	Maximum Pipe Size NPS	Minimum Rod Diameter mm (in)	Maximum Rod Length mm (in)	Maximum Spacing m (ft)
Copper And Steel	up to 3/4	9 (3/8)	n/a	1.5 (5)
	1	9 (3/8)	n/a	1.85 (6)
	1 1/4	9 (3/8)	n/a	2.15 (7)
	1 1/2 to 2	9 (3/8)	n/a	2.5 (8)

Material	Maximum Pipe Size NPS	Minimum Rod Diameter mm (in)	Maximum Rod Length mm (in)	Maximum Spacing m (ft)
	2-1/2 to 3	12 (1/2)	635 (25)	2.75 (9)
	4 to 5	16 (5/8)	785 (31)	3.7 (12)
Steel	6	20 (3/4)	940 (37)	5.2 (17)
Steel	8 to 12	22 (7/8)	1090 (43)	5.8 (19)

- .1 For pipe materials other than listed, refer to manufacturers recommendations for maximum spacing requirements.
- .2 For rod lengths in excess of the tabulated maximum rod length, reinforcing is required per SMACNA Seismic Restraint Manual or the Seismic Engineers written instruction.
- .3 Expansion Compensation
 - .1 Provide structural work and equipment required for expansion and contraction of piping. Provide anchors, guides, and expansion joints as required to adequately protect the piping systems.
 - .2 Provide expansion compensation for all closed piping systems including but not limited to: heating water, chilled water, steam and condensate, closed condenser water systems, and all other closed piping systems that operate at varying temperatures. Expansion compensation may be eliminated from open systems such as domestic cold, domestic hot, domestic hot recirculating systems.
 - .3 All piping shall be anchored and supported in such a manner that strain and/or weight does not come upon any apparatus and pipe branch connections. Expansion joints and compensators shall be installed and guided as per manufacturer's recommendations. All equipment shall be connected with unions or flanges to provide for easy removal. Where piping passes through walls or floor slabs, the sleeves shall be of sufficient size to accommodate the expansion and the pipe insulation, without binding or crushing the insulation or preventing the expansion of the piping.

3.7 Valves

- .1 Install valves in accessible locations with stems upright or angled 45° above horizontal unless approved otherwise. Valves must be accessible without removing adjacent piping.
- .2 Provide stem extensions on all insulated valves.
- .3 Provide ball valves in piping 2 NPS and smaller and butterfly valves or gate valves in piping 2½ NPS and larger for shut-off, equipment isolation, throttling, bypass or manual flow control services. Ball valves used for shut-off/isolation shall be full port.
- .4 Throttling valves are not to be used for shut-off; additional valves shall be installed for isolation purposes.

- .5 Provide isolation valves at branch take-offs, to isolate each piece of equipment, upstream of all meters, gauges, automatic air vents, and as indicated.
- .6 Provide isolation valves in all systems such that floor by floor for horizontal systems, all risers in vertical systems and zone areas on a large horizontal system can be isolated.
- .7 Use swing or soft seated spring loaded check valves in horizontal and vertical upflow pipes and on the discharge of pumps. Spring loaded water check valves shall be located eight (8) pipe diameters downstream of pumps or elbows. Use silent check valves on discharge of pumps and in vertical pipes with downward flow, and as indicated.
- .8 Do not install balancing or throttling valve on discharge of pumps equipped with VFD. Install pressure ports for flow measurement.

3.8 Duct Insulation Minimum Thickness Table (Climatic Zone 5)

Rigid Exterior Duct Insulation				
Duty	Plenum(4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness in mm (in.)				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	125 (5")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	125 (5")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	125 (5")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	25 (1")	125 (5")
Mixed Air (3)	20 (3/4")	20 (3/4")	20 (3/4")	125 (5")
See note (3) for internal duct liner				

Flexible Exterior Duct Insulation				
Duty	Plenum(4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness mm (in.)				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	188 (7-1/2")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	188 (7-1/2")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")

Flexible Exterior Duct Insulation				
Duty	Plenum(4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness mm (in.)				
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	188 (7-1/2")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
See note (3) for internal duct liner				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Where an internal duct liner is used, the thickness shall be selected to match the RSI value specified for external insulation. Internal acoustic duct liner shall be a minimum 25mm (1") where external insulation is not required.

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

3.9 Duct Finishes Table

.1 Conform to the following:

Duty	Rectangular Duct		Round Duct	
	Type	TIAC Code	Type	TIAC Code
Indoor concealed	None	None	None	None
Indoor exposed in mechanical room and elsewhere except utility areas	Canvas Jacket	CRF/1	Canvas Jacket	CRD/1
Indoor exposed in utility areas, parkade, etc.	Utility Finish	CRF/2	Utility Finish	CRD/2
Outdoor exposed to precipitation	Aluminum Jacket	CRF/3	Aluminum Jacket	CRD/3

3.10 Piping Insulation Minimum Thickness Schedule

Type of System	Design Operating Temperature	Thermal Conductivity of Insulation	Nominal Pipe Diameter (NPS)
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	Range °C (°F)	Conductivity Range W/m.°C	Mean Rating Temperature °C (°F)	Runouts ≤ 1	≤ 1	1¼ to 2	2½ to 4	≥ 5
				Minimum Thickness of Piping Insulation (mm)				
Steam & Cond	122-177 (251-350)	0.042-0.045	93 (199)	40	75	100	115	115
	94-121 (201-250)	0.039-0.043	65 (149)	40	65	65	75	75
Heating	61-93 (142-200)	0.036-0.042	52 (126)	25	40	50	50	50
Low Temp Heating	41-60 (106-141)	0.035-0.040	38 (100)	25	25	40	40	40
Chilled Water	5-16 (41-61)	0.030-0.039	24 (75)	25	25	25	25	25
Refrigeration	<5 (41)	0.030-0.039	24 (75)	25	25	40	40	40

Note: Where the thermal conductivity of insulation is greater than the range specified above, increase the thickness by the ratio of U2/U1.

U2 = proposed insulation “k” value at the table mean rating temperature.

U1 = upper range limit “k” value from the table above.

Note: Where thermal conductivity of insulation is less than the range specified above, the thickness may be decreased by the ratio of U2/U1.

U2 = proposed insulation “k” value at the table mean rating temperature.

U1 = lower range limit “k” value from the table above.

3.11

3.11 Piping Finish Schedule

- .1 Indoors concealed; factory finish
- .2 Indoors exposed in mechanical room and elsewhere; canvas jacket
- .3 Indoors, exposed in utility areas, parkade, etc.; PVC jacket

3.12 Seismic Cable Restraints

- .1 Cables must not be allowed to bend across sharp edges.
- .2 Cable assemblies shall suit installation type:
 - .1 Ceiling and at the clevis bolt
 - .2 Between the hanger rod nut and the clevis
 - .3 Clamped to a beam

3.13 Vibration Isolation

- .1 Neoprene Washer/Bushing
 - .1 Isolate variable frequency drive controller using neoprene washer/bushing isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission.
- .2 Rubber Floor Mounts

- .1 Mount in-line pumps on two (2) rubber floor mount isolators under each support foot.
- .2 For equipment mounted on a slab on grade mount on rubber floor mount isolators unless otherwise specified.
- .3 Provide protection of the rubber element from contact with oil in the mechanical room.
- .3 Spring Floor Mounts
 - .1 Isolate all floor or pier mounted equipment on spring floor mount isolators, unless otherwise specified.
- .4 Spring Hangers
 - .1 Locate isolation hangers as near to the overhead support structure as possible.
 - .2 Installation shall permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
 - .3 All discharge ductwork runs for a distance of 15m (50') from the connected equipment shall be isolated from the building structure by means of spring hangers. Spring deflection shall be a minimum of 19mm (0.75").
- .5 Minimum Static Deflection Schedule

Equipment	Equipment Supported By:	
	Slab on Grade	Elevated Slab
Hot Water Boilers	Nil	3mm (1/8")
Heat Pumps (see Note 5)	9mm (3/8")	38mm (1 1/2")
Pumps:		
In-line under 1.5kW (2HP)	1mm (1/16")	3mm (1/8")
In-line 1.5kW (2 HP) to 11.5kW (15 HP)	3mm (1/8")	5mm (1/4")
In-line over 11.5kW (15 HP)	3mm (1/8")	9mm (3/8")
Base mounted under 5.5kW (7.5 HP)	5mm (1/4")	19mm (3/4")
Base mounted 5.5kW (7.5 HP) and greater	19mm (3/4")	38mm (1 1/2")
Fans, Blowers & Packaged H & V Units:		
Under 0.5 HP	1mm (1/16")	1mm (1/16")
0.5 HP to 7.5 HP	25mm (1")	25mm (1")
7.5 HP to 40 HP - up to 400 rpm	38mm (1 1/2")	38mm (1 1/2")
7.5 HP to 40 HP - over 400 rpm	25mm (1")	25mm (1")

- .6 Notes:
 - .1 Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37kW (0.5 HP).
 - .2 Advise consultant of equipment not contained in this table and obtain clarification as to the isolation performance requirements.

- .3 Steel spring isolators shall be used for all deflections 12mm ($\frac{1}{2}$ ") and over.
- .4 Neoprene isolators shall be used for deflections 6mm ($\frac{1}{4}$ ") and under.
- .5 Use housed spring isolators for heat pump.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Provide a complete system of automatic controls to match the base building standard with regard to control devices, components, wiring and materials. All control work associated with the work of Divisions 22 and 23.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts. For general conditions, refer to Section 23 05 02 Heating, Ventilation, and Air Conditioning.

1.3 Code Compliance

- .1 All work shall comply with current editions of the National, Provincial and Municipal Building and Plumbing Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.

1.4 Design Requirements

- .1 Design and provide conduit and wiring linking elements of system to the existing building Energy Monitoring and Control System (EMCS).
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Consultant prior to installation.
- .3 Provide all control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings, and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections, and power not provided by Division 26 but required for the Control System shall be provided under this section.

2. PRODUCTS

2.1 Thermostats

- .1 Relocate and reconnect existing thermostats as shown on the drawings.
- .2 Provide new thermostats where indicated of building standard type. Ensure operating characteristics are compatible with control components (i.e. direct/reverse acting).
- .3 All thermostats to be wall or column mounted [to match existing base building mounting height] [at 1500mm above finished floor] unless specifically noted otherwise.

- .4 All thermostats, existing and new, are to be calibrated prior to air balancing.
Contact building owner if an existing thermostat needs replacing.

2.2 Control Components

- .1 Provide control valves and damper actuators as required to meet the sequence of operation and meet the design intent. Control valves for new mechanical equipment shall be provided by Controls Contractor for installation by the Mechanical Contractor.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **SUMMARY OF WORK**

- .1 The scope of work for this project includes but is not limited to:
 - .1 Construction of new guardhouse for the Institute of Ocean Sciences with all required systems for a complete and operational building including but not limited to:
 - .1 Power distribution
 - .2 Lighting and controls
 - .3 Access Control for Guard House
 - .4 Rough-in of Shares Services Canada (SSC) telephone and communications systems including but not limited to provision of conduits, back-boxes, cover plates, and cable tray.
 - .5 SSC data and communications cabling will be installed by SSC. Coordinate with SSC as required
 - .6 Provision of communications pathways and cabling for CCTV systems within the building for connection by others including but not limited to:
 - .7 Data cabling, pathways, and back-boxes for CCTV cameras installed on the exterior of the guard house.
 - .8 Data cabling, pathways, back-boxes, cover plates, and data outlets for CCTV computer workstation and intercom network connections.
 - .2 Tie-in to underground Security Systems conduits installed by others. Conduits shall be extended to guard house as indicated on Drawings.
 - .3 Coordinate with Security Systems Upgrade contractor as required for installation of gate access control systems and CCTV.

1.3 **CODES AND REFERENCES**

- .1 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.
 - .2 Any reference to Codes, Standards, and Regulations contained within the Contract Documents shall be taken as the latest or most current in effect at time of Tender.
 - .3 In no instance shall the standards established by the Contract Documents be reduced by any referenced Code or Regulation.

- .4 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (Current Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235, 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, The Authoritative Dictionary of IEEE Standards Terms, Current Edition.

1.4 DEFINITIONS

- .1 The word 'Provide' means the supply, delivery, and installation of device or equipment referenced to the level required to be complete and operational.
- .2 The word 'Supply' means to obtain and deliver to the project site, ready for unpacking, assembly, and installation.
- .3 The word 'Install' means the unloading, unpacking, assembling, erecting, applying, finishing, protecting, cleaning and similar operations at the project site to complete items of work supplied by others.
- .4 AHJ: Authority Having Jurisdiction

1.5 RESPONSIBILITY AND COORDINATION

- .1 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical installation as indicated on the Drawings and as set out in these Specifications.
- .2 Without relieving the Contractor of his responsibilities, the Specifications have been divided into approximate trade sections for convenience. These Sections do not, however, limit the responsibility of any subcontractor or supplier. The Departmental Representative will not arbitrate on any dispute between the subcontractors' responsibilities. The onus of defining the extent of the subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular subcontractor is set out in full detail.
- .3 The Contractor shall advise the Departmental Representative during the tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Departmental Representative at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

- .4 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Departmental Representative prior to tender closing. Failing this, the most expensive alternative is to be allowed for.
- .5 Advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.
- .6 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Departmental Representative of space problems before fabricating or installing any material or equipment. Demonstrate to the Departmental Representative on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Departmental Representative's written direction.
- .7 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.
- .8 Ensure that any building structure loaded during the installation is adequate to carry such load.
- .9 Testing in accordance with Section 26 05 10 Testing and Commissioning.
- .10 A contractor is entitled to engage in the regulated work for which the contractor is licensed.
 - .1 A licensed contractor must not:
 - .1 Manage or do regulated work that is:
 - .1 Outside the scope of the license,
 - .2 Contrary to any term or condition of the license, or
 - .3 Contrary to any term or condition imposed by the regulations on the use of the license, or
 - .2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.
 - .2 A licensed contractor must:

- .1 Maintain current knowledge of the Acts, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and
- .2 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.6 SUBSTITUTIONS

- .1 Request for approval of alternate products must be made during tender. Requests for alternate products submitted after Tender award will not be considered.
- .2 Where a product is listed as a 'standard of acceptance' and the Contractor proposes a similar product from a different manufacturer, approval of the similar product as meeting the standard of acceptance is at the sole discretion of the Departmental Representative.
- .3 Substitution of Products After Contract Award
 - .1 After acceptance of the list of products, no substitution of any item will be permitted unless the approved item cannot be delivered in time to comply with the work schedule.
 - .2 To receive acceptance, proposed substitutes must equal or exceed the quality, finish and performance of those specified and/or shown and must not exceed the space requirements allotted on the drawings. Determination of equivalence for substitutes shall be at the Departmental Representative's sole discretion.
 - .3 Provide to the Departmental Representative documentary proof of equality, difference in price (if any) and delivery dates, in the form of certified quotations from suppliers of both specified items and proposed substitutions.
 - .4 Include costs for any required revisions to other structures and products to accommodate such substitutions.

1.7 PERMITS, FEES, AND INSPECTIONS

- .1 Before commencing work obtain and pay for all necessary approvals and permits. The Contractor shall provide printed drawings required by the AHJ to obtain such permits.
- .2 Arrange for inspection of the work at rough-in completion, prior to Substantial Completion, and as otherwise required by all applicable Authorities Having Jurisdiction.
 - .1 Notify Departmental Representative of any changes required by the Authorities Having Jurisdiction prior to proceeding with changes.
- .3 Provide Departmental Representative with a certificate of unconditional approval for all electrical work from the appropriate Authorities Having Jurisdiction. The electrical work shall not be considered substantially complete prior to submission of the inspection certificate.

1.8 EVALUATION OF CONTRACT CHANGES

- .1 Notwithstanding other provisions of the Contract, this Contractor shall supply detailed information for the valuation of all changes to the Contract. Such information shall include, but not necessarily be limited to, the following:
 - .1 Labour hours per unit of material or equipment to be added, deleted, or altered.
 - .2 Units of material or equipment to be added or deleted.
 - .3 Cost to the Contractor per unit of material, equipment and labour broken down by category of labour and type of material or equipment.
 - .4 Extensions of the above to arrive at total costs.
 - .5 Other miscellaneous and identifiable charges such as delivery, restocking, overhead, profit, etc.
 - .6 Include in the valuation of any change to the Contract the cost, if any, of recording such change on the record drawings as previously specified.

1.9 MEASUREMENT AND PAYMENT

- .1 Notwithstanding any other provisions of this Contract, supply the following general information and any additional information as may be requested by the Departmental Representative as part of each Monthly Progress Claim.
 - .1 Indicate the labour cost and the material cost separately for each Item of Work within Divisions 26, 27, and 28.
 - .2 Progress claims will be certified as per contract requirements.
 - .3 Format for Monthly Progress Draws shall be approved by the Departmental Representative prior to the first submission.
 - .4 For each Monthly Progress Draw, each change order shall be listed separately.
 - .5 Indicate both the Change Order number and title on the progress draw.

1.10 REVIEW OF WORK

- .1 The Departmental Representative will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.
 - .1 The Contractor shall notify the Departmental Representative a minimum of 48 hours prior to completion of rough-in to allow review prior to Work being concealed.
 - .2 No work shall be concealed prior to approval by the Departmental Representative.

1.11 SCHEDULING OF WORK

- .1 Work shall be scheduled as required to coordinate with other Divisions and Owner's work restrictions.
- .2 Work Restrictions:

- .1 Coordinate any work which may disrupt facility operations with Departmental Representative a minimum of one (1) week in advance.
- .2 Access to site requires reliability level clearance, or arrangement for escort by a person holding reliability status.
- .3 Become familiar with the phasing requirements for the work and comply with these conditions.
- .4 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.
- .5 Allow to schedule and provide after hours work as required during the course of the project.

1.12 GUARANTEE

- .1 Furnish a written guarantee to the Owner prior to final contract payment, which will be in effect for one year from the date of final acceptance of the complete work. Replace or repair at no cost to the Owner any defective material or workmanship except where, in the opinion of the Departmental Representative, such defects are due to the misuse or neglect by the Owner.
- .2 This general guarantee shall not act as a waiver of any specified of special equipment guarantees which cover a greater length of time.

1.13 FIRE RATING OF PENETRATIONS

- .1 Maintain fire ratings around conduits passing through floors, ceilings and fire rated walls.
- .2 Use fire stop products, at each penetration.
 - .1 All fire stop products shall be submitted as a shop drawing for review prior to use. Submittals shall include both product information sheets and ULC approved fire stop assembly drawings.
- .3 Material of the same manufacturer is to be used throughout the entire project as part of a fully rated fire stop system.
- .4 Acceptable manufacturers: Hilti, 3M or approved equal.
- .5 Refer to Section 07 84 00.

1.14 ACTION AND INFORMATIONAL SUBMITTALS

- .1 All submissions shall be provided in electronic PDF format.
- .2 Submit documents to the Departmental Representative after project award as required by Division 1 specifications and the PSC contract documents.
- .3 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.

- .5 Other pertinent data.
- .4 Certificates:
 - .1 Submit test results of installed electrical systems and instrumentation.
 - .2 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .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.

1.15 SHOP DRAWINGS:

- .1 Accompany submissions with transmittal letter containing the information listed below. Any shop drawings submitted without this information will not be reviewed and will be returned to the contractor for resubmission:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .2 Submissions include:
 - .1 Where specifically noted in other Sections in Divisions 26, 27, and 28, submit drawings stamped and signed by professional Engineer registered or licensed in Province of British Columbia, Canada.
 - .2 Shop Drawings shall be provided for but not limited to the following systems:
 - .1 Firestopping systems for all firestopping required to be installed under Divisions 26, 27, and 28.
 - .2 Distribution equipment including switchboards, panelboards, and transformers.
 - .3 Moulded case breakers whether installed in distribution equipment supplied as part of this project or provided loose.
 - .4 Data racks and passive communications equipment.
 - .5 Lighting.
 - .6 Cables.
 - .7 Wiring devices including but not limited to receptacles and switches.
 - .8 Surface Raceway
 - .9 Cable Tray
 - .10 Access control
 - .11 Security devices
 - .3 Refer to other Sections within Divisions 26, 27, and 28 for detailed shop drawing submission requirements.

- .4 Contractor shall review all shop drawings prior to submittal. All shop drawings shall be stamped and signed by both the Electrical Contractor and General Contractor. Unstamped drawings will be returned without comment.
- .5 Each shop drawing shall clearly indicate the equipment ID and equipment type (e.g. Luminaire Type 'A', Panelboard SD-A) where applicable.
- .6 Where manufactures' brochures that include multiple equipment or device models are submitted, they shall be clearly labelled with the equipment model and options to be supplied at each location. Submit relevant sections of manufacturer's catalogues only. Submissions of complete catalogues will be rejected.
- .7 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
- .8 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .9 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .10 Submit complete shop drawing packages for each system. Partial submissions will be returned without comment.
- .11 Review of shop drawings by the Departmental Representative is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.
- .12 Ensure that copies of all shop drawings are available at the job site.

1.16 CLOSEOUT SUBMITTALS

- .1 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .2 Operation and Maintenance Manuals:
 - .1 Refer to Section 26 05 11 Electrical Operations and Maintenance Data.
 - .2 Provide draft version of Operations and Maintenance Manual to Departmental Representative two weeks prior to Substantial Performance Review.
- .3 Submit record drawings including all as-built information and changes on completion of project. Refer to Section 1.1 As-Built Documents and Samples.
 - .1 Each record drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."

- .2 Provide a copy of record drawings to Departmental Representative for review at Substantial Completion.

1.17 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, at site for Project Manager and Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction in secure location.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.
- .6 Obtain and pay for three sets of white prints. As the project progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each project meeting.
- .7 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run, in relation to the structure and building.
- .8 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- .9 Maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating as-built conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.
- .10 Record Drawing markings shall include but shall not be limited to the following
 - .1 All changes in circuiting
 - .2 Size and routing of all installed feeder raceways and cables.
 - .3 Number and size of conductors in feeder raceways and cables.

- .4 Location of all junction boxes and pull boxes
- .5 Location of all access panels
- .6 Location of all conduit or duct stubs, installed equipment, devices and fixtures
- .7 All changes to electrical installation resulting from Addenda,
- .8 Change Orders and Site Instructions
- .9 Exact location of all services left for future work
- .10 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways
- .11 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .11 Recording Information on Project Record Documents.
 - .1 Record information on set of drawings, and in copy of Project Manual, provided by Project Manager.
 - .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
 - .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
 - .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Changes made by change orders.
 - .2 Details not on original Contract Drawings.
 - .3 References to related shop drawings and modifications.
 - .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
 - .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, as required by individual specifications sections.
 - .7 Provide digital photos, if requested, for site records.

1.18 DELIVERY, STORAGE AND HANDLING

- .1 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .1 Except for equipment intended for installation outdoors, store equipment indoors in dry location.
 - .2 Store and protect equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .3 Packaging Waste Management: remove and dispose of all packaging waste materials.
 - .1 Where possible, return packaging materials to supplier for re-use.
 - .2 Divert all recyclable materials from landfill.

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 in English.

2.2 **MATERIALS AND EQUIPMENT**

- .1 Equipment and materials shall be NEW, CSA certified, and manufactured to standard quoted.
- .2 Where there is no alternative to supplying equipment which is not CSA certified, contractor shall obtain special prior approval from DFO RPSS Departmental representative. CSA equivalent inspection to be performed prior to being put into service.
- .3 Contractor shall use products of one manufacturer to match existing, including classification, unless otherwise specified.
- .4 Unless otherwise specified, Contractor shall comply with manufacturer's latest printed instructions for materials and installation methods.
- .5 Contractor shall deliver, store and maintain materials with manufacturer's seals and labels intact.
- .6 Contractor shall not store materials on site without DFO RPSS Site Authority approval.
- .7 DFO RPSS accepts no responsibility for Contractor materials or equipment stored on site.
- .8 Contractor shall supply shop drawings and manufacturer's instructions and specifications on all new installations for inclusion in the building inventory.
- .9 Where the contractor supplies equipment purchased from a contractor manufacturer, the Contractor shall obtain from the Manufacturer the normal warranty period and such warranty shall be made out to Her Majesty the Queen in right of Canada 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 Sections 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings and Section 26 05 21 Wires and Cables except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of the authority having jurisdiction, code requirements, and as specifically noted in the Contract Documents.
- .2 Engraved signs using rigid phenolic engraving material, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: rigid phenolic engraving material 3 mm, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Nameplate colours as follows:
 - .1 Normal Power Systems: black face, white core
 - .2 Emergency/Standby Power Systems: red face, white core
 - .3 Life Safety Systems: red face, white core
 - .4 Colours for other equipment as specified by the Departmental Representative.

.3 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 to be approved by Departmental Representative prior to manufacture.

- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, 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.
- .5 Refer to Division 28 for communication wiring identification requirements.

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. Colour coding per IOS standards below:

	Prime	Auxiliary
250V regular	Yellow	
250V UPS	Yellow	Orange
250V Emergency	Yellow	Red
600V Regular	Yellow	Green
600V UPS	Yellow/Green	Orange
600V Emergency	Yellow/Green	Red
5kV	Yellow	Blue
25kV	Yellow	Black
Ground	Green	
Telephone	Green	Black
Data	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other security	Red	Black
DDC	Orange	

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of powder coat rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green".
 - .2 Paint indoor switchgear and distribution enclosures light gray.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Pre-Bid Examination
 - .1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting bid.
 - .2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
 - .3 Report to the Departmental Representative any unsatisfactory conditions which may adversely affect the proper completion of this work.
- .2 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 In accordance with CSA C22.1 except where specified otherwise.
- .2 Overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 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: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 IDENTIFICATION OF CODE REQUIRED EQUIPMENT CLEARANCE

- .1 Provide paint outline and hatching of area in front of electrical equipment in service areas denoting working area to remain clear as per Section 2-308 and 2-310 of the Canadian Electrical Code. Paint to be suitable for floor material, coloured safety yellow (RAL 1023). All outline and hatching lines shall be minimum 100mm wide.

3.6 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.7 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: 1150 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1150 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Wall mounted telephone and interphone outlets: 1150 mm.
 - .6 Fire alarm stations: 1150 mm.
 - .7 Fire alarm bells: 2100 mm.
 - .8 Television outlets: 300 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Doorbell pushbuttons: 1150 mm.

3.8 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.9 FIELD QUALITY CONTROL

- .1 Refer to Section 26 05 10 Testing & Commissioning

3.10 SUBSTANTIAL PERFORMANCE REVIEW

- .1 Prior to requesting the Departmental Representative complete a Substantial Performance review, the Contractor shall submit written confirmation that:
 - .1 All wiring devices, cover plates, motor controls, light fixtures and other equipment are operational, plumb, clean, and correctly labelled.
 - .2 All electrical equipment has been cleaned and vacuumed
 - .3 All Test Reports have been submitted including but not limited to data test reports and fire alarm verification reports with no exceptions noted.
 - .4 Factory finished equipment has been cleaned, touched up, or refinished as necessary to present a new appearance.
 - .5 All firestopping/smoke sealing of conduits, cables, cable trays, wireways, etc. at all wall and floor penetrations has been completed.
 - .6 All light fixtures, fixture lenses, and reflectors have been cleaned.
 - .7 All loose equipment including spare parts have been turned over to the Owner.
 - .8 Verification letter from the Seismic Consultant.
 - .9 Draft copy of the Maintenance Manual.

3.11 SYSTEM STARTUP

- .1 Arrange and pay for services of manufacturer's factory service field representative to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .2 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.

3.12 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Where work is performed in a phased manner, or Owner will take partial occupancy of the area of Work, perform final cleaning at the end of each Phase or prior to Owner taking occupancy of each area.
- .4 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 **RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results – Electrical

1.3 **REGULATORY REQUIREMENTS**

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Seismic Consulting Engineer shall provide proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer shall be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC requirements.
- .3 The Contractor's Seismic Consultant shall submit original signed BC Building Code Model Schedules S-B and S-C to the Prime Consultant.
- .4 Importance Factor: 1.5.
- .5 Use the Electrical Contractors Association of BC details in the absence of any local requirements.
- .6 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.4 **SCOPE**

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01 and other Division 26 specification sections.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of

seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender. The contractor shall include for all costs related to seismic restraint.
- .6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the Seismic installation and certification in the base tender.

1.5 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

PART 2 PRODUCTS

2.1 SLACK CABLE SYSTEMS

- .1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.
- .2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.
- .3 Coordinate requirements of slack cables with suppliers prior to installation.

PART 3 **EXECUTION**

3.1 **GENERAL**

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 **CONDUITS**

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.
 - .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.
- .4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Seismic Engineer shall design anchors and bolts.

3.4 LIGHT FIXTURES

- .1 Luminaires installed in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two tight cables which are connected to the fixture at diagonal points.
- .2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.
- .3 Fixtures which are hung independently of ceiling systems shall have minimum of two seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.
- .4 Cables shall be corrosion resistant and approved for the application.
- .5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **EXISTING CONDITIONS**

- .1 Examine site prior to submitting Tender and be responsible for ascertaining all conditions which will affect this trade whether shown on the drawings or not and take all the necessary measurements.
- .2 Investigate and confirm the locations, the method of connections and routes of existing and new electrical facilities. Report at once any discrepancy between drawings, specifications and existing conditions.
- .3 Absorb any costs incurred by failure to carry out this investigation and examination.

1.3 **GENERAL REQUIREMENTS**

- .1 Provide and be responsible for the removal, relocation, reconnection, etc., of electrical devices, equipment, material, etc., as indicated on the drawings and/or as required by renovations to existing building and the installation of new facilities.
- .2 All electrical devices and equipment which are disconnected, removed from service, etc., and which are not reused on the job and not required are to be offered to Owner. If refused, remove from site.
- .3 Continuity of power and communication shall be maintained or restored promptly where services to other portions of a site are affected by renovation or demolition that is outlined on architectural, structural, mechanical or electrical plans or specifications.

1.4 **SHUTDOWNS**

- .1 Outage plan to be provided by the contractor to the Owner and Consultant team for review and approval prior to interruption of any existing services. An pre-outage meeting with the Department Representative is required to review the proposed plan. The general outline of the plan to be submitted as follows:
 - .1 Electrical Power Pre-Change Over Meeting.
 - .1 Meeting time.
 - .2 Personnel required, including specialty personnel (e.g.: utility, mechanical contractor, etc.).
 - .3 Pre-requisite Information: Distribution coordination studies and test results. Generator load test results.
 - .2 List all loads to be shut down.
 - .1 Distribution.

- .2 Sub-distribution.
- .3 Panels.
- .4 Circuits.
- .5 Generators.
- .3 Portable generator requirement to supply equipment during service changeover.
- .4 Schedule.
 - .1 Date and time of each activity.
 - .2 Length of each activity.
- .5 Back out plan.
- .6 Monitoring plan.
- .7 List of personnel to be on site.
 - .1 Electrical contractor foreman and required personnel.
 - .2 Owner representatives and maintenance personnel
- .8 Submit confirmation sheet on panelboards. Trace circuits per Section 1.3

PART 2 **PRODUCTS**

- .1 Manufacturers of existing devices and equipment where known are indicated on the drawings or in the specifications.
- .2 Material and equipment added shall match existing wherever possible unless otherwise noted.

PART 3 **EXECUTION**

3.1 **GENERAL**

- .1 Visit site prior to submitting Tender and make survey of renovation areas. Check out locations and operation of all systems and be aware of all requirements involved in changes and modifications to systems. Consult maintenance staff for any information regarding type and operation of systems. Take into account and allow for all work required to existing facilities to meet requirements as indicated on the drawings and in the specifications.
- .2 Check and be aware of all phasing of work requirements of the project. This would include reading of associated specifications.
- .3 Provide all labour and equipment required to remove existing electrical facilities in the area to be renovated as noted.
- .4 Provide all labour and materials required to revise existing electrical facilities as indicated on the drawings and/or as required by building renovations and for installation of new facilities.
- .5 Existing facilities shall remain operational during construction period. When renovations are complete, all facilities shall be checked and tested and shall be left in a proper working order and to the satisfaction of Engineer and Owner.

- .6 Where walls, ceilings, floors, etc., containing electrical devices, material and equipment, etc., are removed and the deletion of outlets in said areas disrupt service to adjacent devices and equipment, then conduit and wiring shall be provided to pick up adjacent devices and equipment to maintain continuity of service.

3.2 CONDUIT AND CABLE TRAY INSTALLATIONS

- .1 All routes of new conduit and cable tray within existing buildings shall be reviewed and approved by the Departmental Representative prior to installation.
- .2 Existing cable tray, conduits, or conduit supports may only be used where specifically indicated on Drawings or approved by the Departmental Representative.
- .3 Where an alternate conduit or cable tray route is proposed by the contractor, no extra costs will be approved for the alternate route unless it can be demonstrated to the Departmental Representative that the routing shown on the Drawings cannot be used.

3.3 DISPOSAL OF HAZARDOUS MATERIAL

- .1 Dispose of PCB Ballasts, radioactive material in smoke detectors, PCB capacitors, and PCB transformers in accordance with:
 - .1 Canadian Environmental Protection Act (Canada)
 - .2 Canadian Environmental Protection Act - Chlorobiphenyls Regulations (Canada)
 - .3 Provincial Environmental Protection Act
 - .4 Transportation of Dangerous Goods Act, (Canada)
 - .5 Dangerous Goods Transportation and Handling Act
 - .6 Other legislation and regulations which apply to the performance of the work of this section.
- .2 Perform work in accordance with the recommendations in the following Environment Canada publications:
 - .1 Handbook on PCBs in Electrical Equipment by Environment Canada.
 - .2 Identification of Fluorescent Lamp Ballasts Containing PCBs, EPS 2/CG/2, April 1986, by Environment Canada.
- .3 Persons employed for the removal of capacitors and other energized electrical equipment shall be qualified electricians.
- .4 Where contact with liquid PCB is possible, personnel shall be instructed in handling procedures, safety precautions, use of safety equipment and applicable Provincial and Federal legislation and regulation.
- .5 Handling and transportation of hazardous wastes shall be performed by a company registered as a carrier with the Provincial Environment department.
- .6 Submit proof that all persons involved in handling, packing, loading, transportation, unloading, unpacking and disposal of PCB waste are trained in accordance with the Dangerous Goods Transportation and Handling Act.

- .7 Dispose of all radioactive smoke detector components as radioactive waste when, smoke detectors:
 - .1 contain 5 microcuries (185 kilobecquerels) or more of Americium-241 or any amount of Radium.
 - .2 containing less than 5 microcuries (185 kilobecquerels) of Americium-241 are disposed of in quantities of ten or more.
- .8 Dispose of radioactive smoke detector components by making disposal arrangement with one of the following radioactive waste disposal facilities:
 - .1 Original equipment manufacturer.
 - .2 Waste Operations Branch
Atomic Energy of Canada Ltd.
Chalk River, Ontario K0J 1J0
 - .3 Atomic Energy of Canada licensed waste disposal facility.
- .9 Contact selected radioactive waste disposal facility to obtain their instructions for packaging, labeling and shipping of radioactive smoke detector components.
- .10 Package, label and ship radioactive smoke detector components in accordance with waste disposal facility's instructions and in accordance with Provincial and Federal legislation and regulations governing the handling, transportation and disposal of radioactive materials.

3.4 LAMP DISPOSAL

- .1 Contractor to recycle lamps (glass, phosphor, and metal). Provide receipt in maintenance manual for lamp recycling.

3.5 EXISTING SYSTEM SHUTDOWNS

- .1 Where the work of the Contract required shutdown or will otherwise affect and existing electrical system, Contractor must obtain approval from Departmental Representative a minimum of 48 hours in advance. The Departmental Representative may require any outages to be delayed or rescheduled.
- .2 Shutdowns for tie into existing systems may be required after normal working hour to maintain facility operation.
- .3 All costs related to non-coordinated nuisance alarms or the fire alarm system caused by this contractor will be borne by this contractor (i.e. false charges by Fire Department).

3.6 EXCAVATION

- .1 All excavations and exposing of utilities on site to be completed by Hydrovac or hand dig only.
- .2 Prior to Hydrovac, a site meeting is required with the contractor and Owner's representative.

3.7 ASBESTOS

- .1 Asbestos has been found to be present throughout the IOS buildings. The Contractor shall assume that asbestos is present when performing any coring at the IOS facility.**
 - .1 Coring shall be performed per WorkSafeBC requirements for handling asbestos containing materials.
 - .2 Contractor shall submit proposed coring procedures to Departmental Representative for review. Procedures shall prevent contamination of surrounding areas.
 - .3 All coring materials shall be disposed of at an approved location for disposal of Asbestos containing materials.
 - .4 No extras shall be allowed for asbestos abatement and disposal costs related to cutting and coring where these locations are identified on the drawings.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **SUMMARY**

- .1 Test and check all portions of the electrical systems for satisfactory operation. All tests shall be tabulated, signed and incorporated into the Operating and Maintenance Manuals. All testing and commissioning to be carried out under this contract. Procedures and tests outlined below are electrical tests required in addition to normal visual and mechanical inspections which must be carried out prior to placing equipment in service.
- .2 Prior to field testing, obtain applicable copies of factory tests for comparative results.
- .3 Additional testing requirements may be outlined in specific Sections in Division 26, 27, and 28.

PART 2 **PRODUCTS**

- .1 Not used.

PART 3 **EXECUTION**

- .1 General
 - .1 Contractor shall coordinate and pay for all testing required by the Contract Documents including any additional testing required by the Authority Having Jurisdiction.
 - .2 All deficient equipment/devices shall be replaced and retested.
 - .3 Testing for each System shall be performed after the System installation is complete and prior to the system being put into continuous operation.
 - .4 Advise the Consultant a minimum of [three (3)] working days in advance of each test and carry out tests in the presence of the Consultant if required by the consultant.
 - .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .6 Submit detailed typewritten test reports to the Consultant within five (5) working days after the completion of each test. Include all test reports in the Maintenance Manuals.
 - .1 Test reports shall clearly indicate each component that has been individually tested, test results, and whether the results are within acceptable limits.

- .2 Each test report shall be accompanied by a cover sheet outlining the test and summarizing any items that have failed the tests.
 - .1 Cover sheet shall include names, signatures, and contact information of the individuals who conducted the tests.
- .7 Protective Device Setting and Testing
 - .1 All work shall conform to NETA standards.
 - .2 Ensure circuit protective devices including but not limited to overcurrent trips, relays, and fuses are installed to required values per protection and coordination study.
- .2 Contractor Testing:
 - .1 Infra-Red Scanning:
 - .1 Perform infrared scan of all distribution equipment under loaded conditions (new and existing).
 - .2 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, 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.
 - .3 Systems:
 - 1. Access Control
 - 2. Local Area Network
 - 3. Security
 - 4. CCTV
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .5 Switchgear and Switchboard Enclosures:
 - .1 Carry out visual inspection of enclosure and verify nameplate data against vendor as-built drawings and specifications.
 - .2 Torque and ductor test all bus connections and torque test all wire terminations to recommend manufacturer's data. All torqued connections to be sealed with red lacquer.

- .3 Carry out electrical continuity phasing check of all bus work per three line diagram from incoming end to each termination or take-off point.
- .4 Carry out insulation resistance test of all phases to ground and between phases of main bus work. Record results in megohms.
- .5 Contact resistance if applicable.
- .6 Breakers and Load Break Switches
 - .1 clean and lubricate;
 - .2 visual inspection;
 - .3 manual function test;
 - .4 torque test;
 - .5 contact resistant test (100 amp resistance tester);
 - .6 electrical function test;
 - .7 function trip test of all protective relay device.
- .7 Breakers - Molded Case Breakers 150 Amp Frame and Larger:
 - .1 Visually inspect.
 - .2 Ductor test.
 - .3 Megger test.
 - .4 Mechanical function test.
 - .5 Set all units with adjustable magnetic trip units.
 - .6 Where solid state protection is provided with large breakers, test units as follows:
 - .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction.
 - .3 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
 - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .8 Fused or Unfused Disconnect Switches:
 - .1 Visually inspect and clean.
 - .2 Ductor test across switch blade contact surfaces.
 - .3 Megger test.
 - .4 Mechanical function test.
- .9 Transformers
 - .1 Visual inspection of enclosure and all accessories.
 - .2 Torque test all bus connections and cable terminations and seal with red lacquer.

- .3 Megger test.
- .4 Dielectric power factor test.
- .5 Core ground test.
- .6 Ratio test in all tap positions.
- .7 Test operation of temperature and operation of all associated alarm contacts.
- .8 Test and calibrate ground fault relays and function test to trip associated breakers.
- .9 Make voltage and power factor checks throughout building. If directed by the Consultant, adjust transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitably logged and incorporated in the Operating and Maintenance Manuals.
- .10 Transfer Switch - Low Voltage
 - .1 Torque test all bus joints and cable terminations and seal with red lacquer.
 - .2 Ductor test.
 - .3 Megger test.
 - .4 Power up control circuits, simulate loss of normal power and function all devices including timers.
 - .5 Apply device settings as specified.
 - .6 Wiring Checks as listed:
 - .1 Check all control, relaying and instrumentation wiring against vendor wiring schematics, three line diagrams and project specifications.
 - .2 Test each circuit for continuity using a buzzer or similar device.
 - .3 All current circuits shall be injected, all voltage circuits shall be powered at 120 Volts, all devices functioned and checked against control schematic diagram.
 - .4 Check polarity and verify phase relationships on all three phase metering circuits.
 - .5 Where errors are discovered and changes are required, mark up and note required corrective action on vendor prints.
- .11 Microprocessor Type Relays:
 - .1 Mechanical Inspection:
 - .1 Remove cover from relay case carefully. Trip circuit is live circuit and on some relays, it is possible to cause an instantaneous trip while removing relay cover. Inspect cover gasket. Check glass for tightness and cracks.
 - .2 Eliminate unwanted tripping, short-circuit current transformer secondary by careful removal of relay test plug or operation of appropriate current blocks.

- .3 Check connections, circuit boards and modules for tightness.
- .4 Check output relay coils for signs of overheating and brittle insulation.
- .2 Cleaning:
 - .1 Clean glass inside and out.
 - .2 Clean relay compartment as required. Clean relay plug in contacts if applicable, using proper tools.
 - .3 Remove dust and foreign materials from interior of relay using small brush or low pressure 3.2 kg blower of nitrogen.
 - .4 Inspect for any signs of moisture and corrosion.
 - .5 Clean relay output contacts with burnishing tool or non-residue contact cleaner.
- .3 Electrical Testing: Function Tests for typical overcurrent relays include:
 - .1 Energize relay from an appropriate DC power source and check "ON" indication.
 - .2 Time-current function test and trip flag operation.
 - .3 Instantaneous pickup functional trip and flag operation.
 - .4 Use tests listed above for most microprocessor overcurrent type relays.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .12 Solid State Relays:
 - .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instructions.
 - .3 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
 - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test the trip operation.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .13 Motor Control Centre
 - .1 Megger Test all motor feeders
 - .2 Check polarity and verify phase relationships on main feeder and all equipment feeders. Bump Test all existing motors fed from the new MCC.
 - .3 Power up control circuits. Verify operation of all control circuits re-terminated at new MCC.
 - .4 Test operation of each piece of equipment in 'Hand'
 - .5 Test operation of each piece of equipment in 'Auto'

- .6 Where required, verify shutdown of equipment on fire alarm.
- .14 Bus Duct - Low Voltage
 - .1 Visually inspect.
 - .2 Torque test all bolted connections and seal with red lacquer.
 - .3 Megger test.
 - .4 Contact resistance test on total bus duct.
- .15 Devices
 - .1 Test all receptacles for proper polarity, circuitry and grounding.
- .3 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 to Consultant for review. Include field reports in Operations and Maintenance Manuals.
 - .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 Obtain manufacturer's field services for commissioning of equipment as required in other Sections of Division 26, 27, and 28 specifications.
- .4 Testing by Independent Testing Agency
 - .1 Contractor shall arrange and pay for system testing to be performed by an independent testing agency.
 - .2 All required testing shall be completed and any deficiencies corrected prior to energizing equipment.
 - .3 Check resistance to ground before energizing any equipment.
 - .4 Contractor shall provide all necessary tools, material, and labour to prepare the equipment for testing, to assist the testing agency representatives during the tests, and to re-connect equipment on completion of testing.
 - .1 Include in Bid price all costs associated with the coordination of testing, provision of labour required to carry out testing, and required materials other than testing instruments.
 - .5 The following tests shall be performed by the independent testing agency:
 - .1 Fire alarm systems
- .5 Conduct additional testing as required in other Sections in Division 26, 27, and 28.

3.2 STANDARDS

- .1 The following tests shall be conducted in accordance with latest CSA, ASTM, IEEE and IPCEA standards, recommendations for power cable and equipment testing and authority waving jurisdiction. Notwithstanding, the test levels listed in these standards, in no case shall the maximum DC test level exceed manufacturer's factory test AC level for that equipment.

- .2 Where production tests are required by EEMAC or CSA for manufactured equipment, provide records of these tests.
- .3 All tests shall be completed in accordance with manufacturer's published instructions. If these instructions do not conform to the test requirements as specified herein inform the Engineer prior to proceeding with the test.

3.3 TEST APPARATUS AND INSPECTION REPORT

- .1 The testing company to be responsible for furnishing all apparatus and labour required for the test operations.
- .2 Inspection and test results to be recorded on a suitable form which shall be furnished by the testing company. The inspection and report forms shall be submitted to the Engineer. Each form to be signed by the test technician. Space to be provided for noting approved items and their disposition.
- .3 Testing company to submit full commissioning reports and information for as-built drawings and acceptance documents signed by test technician.
- .4 Upon completion of the project, the testing company to assemble complete sets of inspection/test results/reports to be placed in the operating and maintenance manuals.

3.4 SYSTEM ACCEPTANCES

- .1 Prior to requesting inspection, submit, for review by the Consultant letters from the Manufacturers of equipment and systems indicating the their Technical Service Representative have inspected and tested the equipment and systems and are satisfied with the methods of installation, connections and operation.
- .2 Acceptance letters shall be submitted for the following:
 - .1 Distribution and Power Panels.
 - .2 CCTV
 - .3 Access Control
 - .4 Security

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **RELATED REQUIREMENTS**

- .1 Electrical Systems Testing and Commissioning Section 26 05 10.

1.3 **WORK INCLUDED**

- .1 Provide operation and maintenance data as specified herein for incorporation in operation and maintenance manuals. Before requesting final certificates, submit copies of the operation/maintenance manuals.

1.4 **MANUALS**

- .1 Submit three (3) hard copy bound sets and one (1) digital set of the operations and maintenance manual on CD or USB memory stick.
 - .1 Submit one draft hard copy to the Consultant for review at Substantial Completion prior to final issue.
- .2 O&M Manual Format
 - .1 Organize data as instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
 - .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
 - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .7 Text: manufacturer's printed data, or typewritten data.
 - .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
 - .9 Provide to scale CAD files in dwg format on CD.
- .3 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .4 Contents:

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 - .6 Training: refer to Section 26 05 12 Electrical Equipment and Systems Demonstration and Training.
- .5 The divider tabs shall be laminated Mylar plastic and coloured according to Section . Plastic tabs with typewritten card insertions will not be accepted. Index manuals as follows:
 - .1 Tab 1.0 Division 26, 27, and 28 System complete with title page.
 - .2 Tab 1.1 List of Division 26, 27, and 28 Drawings
 - .3 Tab 1.2 Description of Systems
 - .4 Tab 1.3 Equipment Suppliers and Parts
 - .5 Tab 2.0 (.1, .2, etc.) Shop Drawings.
 - .6 Divider tabs shall be mylar plastic and colour coded.
- .6 Each manual shall contain:
 - .1 Table of contents. Arrange contents sequentially by systems under section numbers. Label tabs of dividers between each to match section numbers in table of contents. Table of contents to be reviewed and accepted by consultant prior to final assembly of manual.
 - .2 Name and contact information of all project Contractors including all Electrical subcontractors.
 - .3 Copies of all contractor and subcontractor statements of warranty.
 - .4 Name and contact information of all Electrical equipment suppliers.
 - .5 Systems Descriptions. A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .6 Descriptive and technical data.

- .7 Maintenance and operating instructions for all electrical equipment and controls. (These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the Owner in the proper operation and maintenance of this installation.)
- .8 Lubricating and servicing intervals recommended.
- .9 A copy of all wiring diagrams complete with wire coding.
- .10 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.
- .11 Copy of test data.
- .12 A motor list showing each motor number, name, horsepower, nameplate, current rating, heater size and type, and current being drawn.
- .13 Include type and accuracy of instruments used.
- .14 Set of final reviewed Shop Drawings.
- .15 Provide manufacturer's installation instructions for all systems and components.
- .16 provide manufacturer's operation instructions for all systems and components
- .17 Provide manufacturer's maintenance instructions for all systems and components. Include the following:
 - .1 Complete parts list for all serviceable components, including description and catalogue number.
 - .2 List of spare parts supplied under the Contract and list of other spare parts recommended by manufacturers.
- .18 Provide copies of all inspection certification reports from authorities having jurisdiction.
- .19 Provide copies of reports documenting the results of all tests, including factory tests, required by the Contract Documents to be performed.
- .20 Provide copies of all manufacturer's warranties.
- .21 Record Drawings.
- .22 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.
 - .6 Recommended spare parts

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **INTENT**

- .1 Provide demonstration and instruction sessions to familiarize Owner's operation and maintenance personnel with electrical systems and their operation and maintenance.

1.3 **MANUFACTURER'S SITE SERVICES**

- .1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction seminars for systems specified in this Section.

1.4 **DEMONSTRATION AND INSTRUCTION SEMINARS**

- .1 Present Operator Training Seminar.

1.5 **SUBMITTALS**

- .1 Include proof of attendance at demonstration and instruction seminar as part of the O&M Manual as per section 26 05 11 Electrical Operations and Maintenance Data

PART 2 **PRODUCTS**

- .1 Not used.

PART 3 **EXECUTION**

3.1 **SYSTEMS AND EQUIPMENT DEMONSTRATIONS AND INSTRUCTION SEMINARS**

- .1 Provide demonstration and instruction seminars for the following equipment and systems identified. Include in demonstrations and instruction seminars, the information specified for each piece of equipment and system.
 - .1 Access Control System
- .2 Obtain sign-off from attending personnel at system demonstration. System will not be considered to have been demonstrated until proof of attendance is presented.

END OF SECTION

PART 1 **CONCRETE WORK**

- .1 All concrete required for and/or installed under Division 26 shall be as specified in other Divisions. Unless otherwise noted, it shall have a specified strength of 20,000 kPa(3000 psi) at 28 days and an entrained air content of 6% \pm 1%.
- .2 Use proper placement techniques to remove entrained air. Do not place thereon or attach thereto any materials or equipment prior to a minimum curing period of seven (7) days.
- .3 Vibrators shall be utilized for the placement of all concrete.

PART 2 **HOUSEKEEPING PADS**

- .1 Provide steel reinforced concrete housekeeping pads/bases of minimum 100 mm height for all floor mounted equipment, including but not limited to switchgear, auxiliary system cabinets, etc. Size pads with reference to equipment shop drawings and so as to include for the installation of future equipment where future extensions to equipment are shown or noted.
 - .1 Housekeeping pad reinforcing and equipment anchorage shall be specified and reviewed by the Contractor's Seismic Engineer.

PART 3 **OPENINGS**

3.1 **OPENINGS AND SLOTS**

- .1 Provide all openings as necessary and as specified elsewhere to permit the installation of all conduits and cables and recessed equipment and devices.
- .2 Grind and file smooth the interiors and edges of all sleeves and slots prior to pulling any cables.

PART 4 **WALL, CEILING, AND FLOOR PENETRATIONS**

- .1 Any and all penetrations through walls, ceilings and floors (fire, smoke, sound as well as all other penetrations) must be sealed after the installation of all conduits, cables, bus ducts, cable trays, wireways, etc., to maintain the integrity of the separations in a manner approved by the Consultant and the authorities having jurisdiction. Use sealing materials as specified herein and shown on the drawings.
- .2 Rated sealing systems for penetrations of Fire Rated walls, ceilings and floors: Hilti, or approved equal, refer to the drawings. Contractors are to submit ULC, cUL, WHI, or equivalent certified Design or System Data Sheets to demonstrate compliance of a particular Floor or Wall Assembly, Through Penetrant, and Sealant with requirements and for what period of time.

- .3 Provide bus ducts, cable trays, wireways, etc., with fire barriers at each floor and at each fire separation and smoke separation, and further seal against the migration of smoke.
- .4 Seal all slots, core holes, etc., not being used.
- .5 Provide fire-rated gypsum board of required thickness around all surfaces of recessed panelboards and cabinets within rated separations so as to maintain the separation rating as approved by the authorities having jurisdiction.
- .6 Provide fire-rated gypsum board enclosures for lighting fixtures recessed in fire rated ceiling assemblies, all as required by the authorities having jurisdiction.

PART 5 WATERPROOFING/VAPOUR BARRIERS

- .1 Generally, penetrations through waterproofing members and vapour barriers will not be permitted. However, where any work must pierce vapour barriers and waterproofing membranes including waterproofed concrete, the method of installation, colour of caulking material and location of penetration shall be as approved by the Consultant and as coordinated with Structural Engineer prior to proceeding with the work. Supply and install all necessary sleeves, caulking and flashing and make the penetrations watertight. For penetrations of vapour barrier, maintain integrity of the system. Restore penetrations through existing surfaces to match the surroundings.
- .2 Provide specified caulking around all exterior recessed lighting fixtures in concrete steps, walls, etc.
- .3 Provide clear silicon bead on top and down both sides of all exterior wall mounted devices (e.g. light fixtures and gongs) where devices are exposed to the weather.

PART 6 EQUIPMENT FINISHES

- .1 Thoroughly degrease all metalwork and apply one overall coat of zinc chromate primer to all electrical equipment enclosures, supports, switchgear cubicles, bus ducts, gutters, panelboards, low tension and other cabinets. Unless otherwise directed, apply one overall coat of grey enamel and a second coat of gloss enamel. Paint all exposed surfaces.
- .2 Grey ASA #61 unless matching existing equipment in which case colour shall match existing.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Ensure that equipment finishes are not defaced during installation. Scratched or otherwise marred surfaces shall be refinished before the job will be accepted. Other surfaces shall

be completely repaired to match original paint. Patching of damaged area will not be accepted.

- .4 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.
- .5 Generally, equipment finishes shall be as outlined under applicable sections of the specifications.

PART 7 VIBRATION AND NOISE CONTROL

7.1 MOUNTING

- .1 Electrical equipment such as transformers and standby diesel engine generator sets shall be mounted using vibration isolators. Isolators shall be selected in accordance with the weight distribution of equipment so as to produce the manufacturers' recommended uniform deflection. Such equipment shall be restrained at each isolator pad using bolts into the floor slab with neoprene washers and clearance holes to prevent short circuiting.

7.2 CONNECTIONS

- .1 Connections to rotating, vibrating, or other noise-producing equipment such as motors, generators and transformers shall be by means of flexible conduit and flexible stranded conductors so as to minimize transmitted noise and vibration. Where equipment is mounted by means of resilient supports and is subject to physical displacement under such conditions as energizing a motor, the flexible conduit connections shall be formed into a loop of sufficient length to permit freedom of travel.

PART 8 ACOUSTICAL SPECIFICATIONS FOR TRANSFORMER

8.1 GENERAL

- .1 Supply transformers generating a space average noise level in the respective Electrical Rooms not exceeding 70 decibels (re: 20 microPa) measured in any third octave bank between 50 Hz and 1,000 Hz based on a 300 kVA transformer.
- .2 Log kVA re: 300 kVA. Use a room absorption equivalent to 1/3 of the floor area. Supply the name of a similar installation.
- .3 Sound level measurements made at the project site will be made in general accordance with ANSI Standard S1.32, recognizing that the respective Electrical Rooms may not meet the full requirements of the Standard.
- .4 Supply vibration isolation such that the airborne noise isolation provided by the building structure is not limited by structure-borne noise transmission. The following are minimum isolation requirements:

- .1 Mount the transformer core on 25 mm (1") deflection spring isolators, including in- series neoprene elements with an effective deflection of 2.5 mm (.10") and use restraints meeting the National Building Code with respect to seismic requirements. (Also refer to Section 16192 Seismic Restraints).
- .5 Where a transformer is located on a slab on grade, use pad isolators sized for a minimum 2.5 mm (.10") deflection, with seismic restraints.
- .6 If the transformer core is mounted on separate transverse steel supporting members independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm (.0005") dead load cantilever deflection) and the isolator stiffness.
- .7 Where smaller transformers are supplied with core bolted into steel supports within the cabinet, supply neoprene pad isolation within cabinet with minimum 2.5 mm (.10") deflection working against the vibration isolation provided the isolator/pad supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets and all other associated equipment on the neoprene pads with 2.5 mm (.10") deflection and isolate the conduit to meet the requirement.
- .8 For 10 metres (30') in all directions from the transformer, provide neoprene hangers with 0.1" Static deflection in threaded rod supports for conduit, cable trays, etc. Avoid rigid connections to the structure.
- .9 Submit shop drawings detailing proposed isolation.

PART 9 **PRODUCTS**

- .1 Mason Z-1011 seismic restraints.
- .2 Mason SLFH open spring isolators.
- .3 Mason Super W pad isolator, 50 durometer.
- .4 Mason HD hangers.

PART 10

- .1 Locate all mechanical equipment, electrical conduit, and lighting at least 300 mm (12") below the ceiling slab, including wall-mounted equipment. Do not locate mechanical ducts over transformer cabinets.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65, 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, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results - Electrical.

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 NEMA to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for TECK cable as required to: CAN/CSA-C22.2 No.18.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws [with appropriate compression tool recommended by manufacturer]. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.3 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG except where permitted by the IOS Site Authority or Departmental Representative.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated R90 XLPE Non-Jacketed.
- .3 Aluminum Conductors: not permitted.

2.2 **TECK 90 CABLE**

- .1 Teck cable permitted only where explicitly indicated on Drawings or where agreed to in writing by Departmental Representative.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

- .2 Channel type supports for two or more cables at 1500 mm centers maximum. Provide additional supports as required to prevent sagging of cables.
- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 MINERAL-INSULATED CABLES

- .1 Not Required.

2.4 ARMOURED CABLES

- .1 Not permitted.

2.5 ALUMINUM SHEATHED CABLE

- .1 Not required.

2.6 CONTROL CABLES

- .1 Type: LVT: soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT:
 - .1 Insulation: TW.
 - .2 Shielding:
 - .1 Tape coated with paramagnetic material over each pair or over conductors as indicated.
 - .2 Provide shielding where indicated on Drawings.
 - .3 Overall covering: PVC jackets for installation in cable tray or conduit.

2.7 NON-METALLIC SHEATHED CABLE

- .1 Not Permitted.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 10 – Testing and Commissioning.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in conduits in accordance with Section 33 65 76 Direct Buried Underground Cable Ducts, 26 05 43.01 Installation of Cables in Trenches and Ducts, and Section 26 05 34 Conduits, Conduit Fastenings, and Conduit Fittings.

- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.
- .10 Megger test all cables and conductors and provide results to Departmental Representative prior to terminating.

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 33 65 76 Direct Buried Underground Cable Ducts.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable as indicated on Drawings or as approved in writing by Departmental Representative.

3.5 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Not Required.

3.6 INSTALLATION OF ARMOURED CABLES

- .1 Not Required.

3.7 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Not Required.

3.8 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit or cable troughs as indicated on drawings.

.2 Where present, ground control cable shield at one end only.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
 - .2 CSA International
 - .1 CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated on Drawings.
- .3 Rod electrodes: copper clad steel, 19 mm diameter by minimum 3 m long.
- .4 Plate electrodes: Not Required.
- .5 Grounding conductors: bare stranded copper, soft annealed, size as indicated on Drawings or per CEC where not indicated on Drawings.
- .6 Insulated grounding conductors: green, copper conductors, size as indicated.
- .7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .8 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 Compression type connectors Burndy Hy-Press or approved equal.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

PART 3 **EXECUTION**

3.1 **INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Where EMT or RGS is used, run ground (bond) wire in conduit.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837 (Burndy, Hypress or equal).
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Install bonding wire for flexible conduit, connected at [both] [one] end[s] to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Install separate ground conductor to outdoor lighting standards.
- .11 Connect building structural steel and metal siding to ground by welding copper to steel.
- .12 Make grounding connections in radial configuration only, with connections terminating at single grounding point as indicated on Drawings. Avoid loop connections.
- .13 Bond single conductor, metallic armoured cables to cabinet at supply end.

3.2 **MAINTENANCE HOLES**

- .1 Not Required.

3.3 **ELECTRODES**

- .1 Install electrodes and make grounding connections as indicated on Drawings.
- .2 Bond separate, multiple electrodes together.
- .3 Size copper conductors for connections to electrodes as indicated on Drawings.

3.4 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, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections minimum size 2/0AWG or as indicated on Drawings.

3.6 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Sound, fire alarm, security systems, intercommunication systems as indicated.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 – Testing and Commissioning
- .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.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Not Required.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results - Electrical

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as required.
- .2 Cord Grips: Kellems grip Type 073-03 and 073-04 or approved equal.
- .3 Wire and cable ties: nylon 'Ty-rap' or approved equal for wiring and control cable. Velcro cable wraps for data cables.
- .4 Threaded hanger rods: galvanized steel, minimum 6mm diameter; larger sizes as shown on drawings or as required.
- .5 Conduit and cable clamps for individual or pair runs:
 - .1 One-hole steel or galvanized malleable iron for sizes 53mm and smaller.
 - .2 Two-hole steel for sizes larger than 53mm.
- .6 Fixture suspension chain: #3 Tenso chain.
- .7 Backboards: New 21mm (3/4") G1S paint grade fir plywood.
 - .1 Paint with fire-retardant paint.
- .8 Conductor supports for vertical runs: O-Z Electrical Mfg. Co. Type 'S' or 'R' as required or equal, for not more than 5 wires or cables each not greater than 250 kCMIL. Kellems grip Type 022-11 or approved equal for all manufacturer-approved combinations of wires and/or cables.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole 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.
- .7 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.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Do not use existing supports for electrical conduit or cable except with permission of Departmental Representative.
- .14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **SPLITTERS**

- .1 Not Required.

2.2 **JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers for indoor use.
- .4 NEMA 4X rated for outdoor locations.

PART 3 **EXECUTION**

3.1 **SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 **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 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 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 on Drawings.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

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.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 **GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square or larger outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.4 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex or single receptacles as indicated on Drawings. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 21 and 27 mm conduit. Minimum size: 73 mm deep.

2.5 CONDUIT BOXES

- .1 Cast FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.
- .2 Non-metallic sheathed cable shall NOT be used on this project.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 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, foam, or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No. 62, Surface Raceway Systems.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **SURFACE RACEWAY SYSTEM (WIRING PULLED IN)**

- .1 Not Required.

2.2 **SURFACE RACEWAY SYSTEM (WIRING LAID IN)**

- .1 Two-piece steel assembly CAN/CSA-C22.2 No. 62.
 - .1 Finish: anodized aluminum. Confirm colour at shop drawing stage.
- .2 Standard of Acceptance: Legrand Wiremold DS4000
- .3 Removable cover.
- .4 Corners, pull boxes, elbows, tees, two-piece assembly to facilitate site wiring.
- .5 Provide integrated receptacles, data outlets, extension boxes, adapters, t-fittings, corner fittings, and all other fittings and accessories required for complete installation.
- .6 Divided raceway for 120V power and communications wiring.
- .7 Raceway capacity shall have a minimum of 20% spare capacity for No. 12 AWG power wiring, and 30% spare capacity for Cat6 data cabling.

2.3 **SURFACE FLOOR RACEWAY SYSTEM**

- .1 Not Required.

2.4 CHANNEL RACEWAY

- .1 Channel type raceway: to CAN/CSA-C22.2 No. 62, steel, solid.

2.5 PLASTIC RACEWAY

- .1 Not Permitted.

2.6 LIGHTING FIXTURE RACEWAY

- .1 Not Required.

2.7 FITTINGS

- .1 Elbows, tees, supports, connectors couplings and fittings: to CAN/CSA-C22.2 No. 62.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install raceway systems as indicated and in accordance with manufacturer's instructions.
- .2 Install supports, elbows, tees, connectors, fittings, bushings, adaptors as required.
- .3 Keep number of elbows, offsets and connections to minimum.
- .4 Use wiring with mechanical protection in channel raceways.
- .5 Install barriers in raceways for different services where required by code.
- .6 Install wiring after installation of raceway system is complete.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (Current Edition).

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 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.

PART 2 **PRODUCTS**

2.1 **CABLES AND REELS**

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

2.2 **CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum threaded.

- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83-1976, with couplings.
- .3 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56-1977

2.3 CONDUIT FASTENINGS

- .1 One-hole malleable iron or galvanized steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18-1972, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Note: BX, PVC and aluminum conduit not acceptable, except for short flexible connections to light fixtures from conduit boxes, not to exceed 2 meters in length per cable.

- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .4 Surface mount exterior conduits unless noted otherwise.
- .5 Conceal interior conduits above accessible ceiling spaces except in service rooms.
- .6 Use rigid aluminum threaded conduit outdoors, above ground.
- .7 Use electrical metallic tubing (EMT) indoors above 2.4 m not subject to mechanical injury.
- .8 Install separate ground wire in EMT.
- .9 Use rigid PVC conduit underground.
- .10 Flexible metal conduit runs shall not exceed 1200 mm.
- .11 Minimum conduit size: 35 mm except where noted otherwise on Drawings.
- .12 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 19 mm diameter.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Install fish cord in empty conduits.
- .16 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.
- .17 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .18 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on [surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.

- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA FG 1, Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1, Metal Cable Tray Systems.
 - .3 NEMA VE 2, Cable Tray Installation Guidelines.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **CABLETROUGH**

- .1 Cabletroughs and fittings: to CAN/CSA C22.1 No.126.1.
- .2 Wire mesh type, CAN/CSA C22.2 No.126.1.
 - .1 Minimum width: 300 mm
 - .2 Minimum Depth: 102 mm
- .3 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
- .4 Barriers where different voltage systems are in same cabletrough.
- .5 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .6 Provide fire stop material at firewall penetrations.

2.2 **SUPPORTS**

- .1 Provide splices, supports for a continuously grounded system as required.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 **CABLES IN CABLETROUGH**

- .1 Cabletrough for extra low voltage cabling only including but not limited to communications, access control, and security cabling.
- .2 Install cables individually.
- .3 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .4 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .5 Identify cables every 30 m and on both sides of walls where Tray passes through walls with size 2 nameplates in accordance with Section 26 000 – Common Work Results Electrical.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.3 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **CABLE OR CONDUIT MECHANICAL PROTECTION**

- .1 Provide cable/conduit mechanical protection only where specifically indicated on Drawings or as approved by Departmental Representative in writing to reduce the cable depth of cover.
- .2 50mm concrete.

2.2 **MARKERS**

- .1 Not Required.

PART 3 **EXECUTION**

3.1 **DIRECT BURIAL OF CABLES**

- .1 Not Permitted.

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 Not Required.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 Testing and Commissioning.
- .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 for power cables:
 - .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 for power cables:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 100% of original factory test voltage 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 specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Refer to Division 28 for acceptance tests for communications, access control, and other extra low voltage wiring.
- .8 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .9 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.184.1, Solid-State Dimming Controls (Bi-national standard with UL 1472 updates).

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings to be submitted in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **ROOM CONTROLLERS**

- .1 Provide Room controllers as indicated on Drawings.
- .2 Standard of acceptance: Douglas Controls WR-4222

2.2 **LINE VOLTAGE OCCUPANCY SENSORS**

- .1 Line Voltage occupancy sensors where indicated on Drawings
 - .1 Wall-mount combination switch/occupancy sensor.
 - .2 Voltage: to suit lighting circuits being controlled
 - .3 Standard of acceptance: Douglas WOS Wall Switch Sensor WOSSDU1-P-VW

2.3 **LOW VOLTAGE OCCUPANCY SENSORS**

- .1 Standard of acceptance:
 - .1 Wall Mount: Douglas WOS Wall Switch Sensor WOSSDU1-P-VW
 - .2 Ceiling Mount: Douglas Ceiling Mount Occupancy Sensor
- .2 Wall mount or ceiling mount as indicated on Drawings
- .3 Wall mount complete with manual on/off switches

- .4 Provide additional control contactors or relays for multi-circuit switching as required.
- .5 Dual Technology passive infrared and ultrasonic with adjustable sensitivity
- .6 Configurable for either Occupancy Sensor or Vacancy Sensor operation
- .7 Wall mount to be Decora style. Provide complete with cover plate. Refer to Section 26 27 26 Wiring Devices for cover plate requirements.
- .8 Connect to room controller.

2.4 LOW VOLTAGE DIMMING AND ON/OFF SWITCHING

- .1 Integrated on/off switching and dimming.
- .2 Standard of acceptance: Douglas Dialog 3500 Series.
 - .1 Provide number of switches as required for number of switching and dimming zones in each area.
- .3 Connect to room controller.

2.5 MANUAL ON/OFF SWITCHING

- .1 Individual switches ganged as indicated.
- .2 Single or double pole, single or double throw as required to suit switching shown on drawings.
- .3 Provide additional control contactors or relays for multi-circuit switching as required.
- .4 Key operated where shown on drawings
- .5 Motor rated where shown controlling motor circuit.
- .6 Decora style commercial grade. Provide complete with cover plate. Refer to Section 26 27 26 Wiring Devices for cover plate requirements.
- .7 Colour: white

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 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.
- .2 Where lighting control devices are to be located in close proximity, they shall be ganged with a common device box and cover plate, with voltage barriers as required.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 Testing and Commissioning.
 - .2 Demonstrate dimming systems operate as intended and there are no problems in starting lamps, nor in keeping them lit, and free of perceptible flicker at required settings of dimming intensity control.

3.4 CLEANING

- .1 Clean lighting control elements prior to project completion and handover to owner.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **DESIGN DESCRIPTION**

- .1 Design
 - .1 Type: ANN.
 - .2 60 Hz.
 - .3 kVA, Phase, and Voltages as indicated on Drawings.
 - .4 Voltage taps: standard.
 - .5 Insulation: Class 220 degrees C temperature rise.
 - .6 Basic Impulse Level (BIL): standard.
 - .7 Hipot: standard.
 - .8 Average sound level: standard.
 - .9 Impedance at 17 degrees C: standard.
 - .10 Enclosure: NEMA, removable metal front panel.
 - .11 Mounting: as indicated on Drawings.
 - .12 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .13 Copper windings.
 - .14 Winding configuration to be as noted on drawings.

- .15 Harmonic Mitigating Phase Shifting transformers as indicated on drawings.
- .16 K-Rating: 13
- .17 Voltage Regulation to be 4% or better.
- .18 Sprinkler-proof shield.
- .19 Vibration dampers.

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 shall include equipment name, transformer kVA, primary and secondary voltage, impedance (%), upstream distribution panel and circuit.
 - .1 Confirm nameplate wording with Consultant prior to manufacture.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Bus and breakers rated as indicated on Drawings. Symmetrical interrupting capacity as indicated on Drawings but not less than 10kA.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel
- .11 Isolated ground bus.

- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .13 Provide minimum additional space for future breakers in panelboards as follows:
 - .1 Panelboards 208V, up to 225A: minimum 20% space and 10% spare 15A breakers or as noted on Drawings
 - .2 Distribution panelboards 208V, over 225A: 20% space or as noted on Drawings
 - .3 Distribution boards greater than 208V: 20% or as noted on Drawings

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for fire alarm and exit circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved [as indicated].
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved [as indicated].
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.
- .5 Circuits supplying Patient Care Areas must be entered in circuit directory with Bold Font.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus.

- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55, Special Use Switches.
 - .4 CSA C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).
 - .5 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **SWITCHES**

- .1 Rating and voltage as indicated on Drawings.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Horsepower rated for motor loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type and amperage as indicated on Drawings, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .6 Decorator style
- .2 Single receptacles CSA type and amperage as indicated on Drawings, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A, 120 V circuit interrupter and decorator style duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 Recessed CSA Enclosure 1 with white cover plate where installed indoors.
 - .4 NEMA4 Enclosure complete with weatherproof while in use cover plate where installed outdoors.

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.
- .6 Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

PART 3 EXECUTION

3.1 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 or as indicated on Drawings.
- .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 or as indicated on Drawings.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated on Drawings.
- .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.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).
 - .2 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit PDF copy of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **BREAKERS GENERAL**

- .1 Breakers shall be installed in existing panels.

- .2 Moulded-case circuit breakers, ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .3 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .4 Plug-in moulded case circuit breakers: not accepted.
- .5 Common-trip breakers: with single handle for multi-pole applications.
- .6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating to match existing panels.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Not Required.

2.3 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.

2.4 MAGNETIC BREAKERS

- .1 Not Required.

2.5 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS

- .1 Not Required.

2.6 SOLID STATE TRIP BREAKERS

- .1 Not Required.

2.7 OPTIONAL FEATURES

- .1 Include:
 - .1 On-off locking device where indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Contractor shall confirm manufacturer and model of existing panel boards to ensure compatibility of new breakers to be installed.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **MATERIALS**

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144. Components comprising ground fault protective system to be of same manufacturer.
 - .1 Provision for testing and reset.
 - .2 CSA Enclosure 1, flush mounted.
 - .3 Ground fault trip indicating light.
 - .4 Resistor type fused artificial neutral.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Pass phase conductors through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical And 26 05 10 Testing and Commissioning.
- .2 Arrange for field testing of ground fault equipment Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162 and UL 98).
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **DISCONNECT SWITCHES**

- .1 Non-fusible disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 [relocatable and] suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 **EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA-C813.1, Performance Test Method for Uninterruptible Power Supplies.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .1 Include the following Shop Drawing information:
 - .1 Outline schematics showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.
 - .2 Catalogue information.
 - .3 Shipping weight.
 - .4 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.
 - .5 Wiring diagram and connections for all accessories and external interfaces (e.g. alarms)
 - .6 Description of system operation, referenced to schematic diagram, for:
 - .1 Manual control during initial start-up and load transfer to bypass and back to inverter output.
 - .2 Inverter.
 - .3 Bypass.
 - .7 Estimate with supporting data for Mean Time to Repair factor (MTTR).
 - .8 Full load kVA output at 0.9% lagging power factor.
 - .9 Voltage drop at UPS output.
 - .10 Efficiency of system at 25%, 50%, 75% and 100% rated load.
 - .11 Type of ventilation: natural or forced.
 - .12 Battery:
 - .1 Number of batteries.
 - .2 Maximum and minimum voltages.
 - .3 Type of battery.
 - .4 Catalogue data with battery trade name and type.
 - .5 Size and weight of each battery.

- .6 Battery charge and discharge curves of voltage, current, time and capacity.
- .7 Derating factor for specified temperature range.
- .8 Nominal ampere hour capacity of each battery.
- .9 Maximum short circuit current.
- .10 Maximum charging current expected for fully discharged condition.
- .11 Recommended low voltage limit for fully discharged condition.
- .12 Expected life.
- .13 Inverter:
 - .1 Type and catalogue number.
 - .2 DC current at minimum battery voltage to produce full load AC output.
- .14 Rectifier:
 - .1 Type and capacity, with catalogue number.
 - .2 Battery charging sequence.
 - .3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices.
 - .4 Guaranteed noise level.
 - .5 Estimated life.
 - .6 Metering.
 - .7 Alarms.
- .15 Manufacturer's field experience with UPS of similar ratings including engineering expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.
- .16 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.
- .17 Cooling air required in m³/s.
- .18 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.
- .19 Typical operation and maintenance manual.
- .20 Description of factory test facilities.
- .21 Manufacturer's maintenance capabilities including:
 - .1 Willingness to undertake maintenance contract.
 - .2 Number of trained personnel available.
 - .3 Location of trained personnel and repair facilities.
- .22 Manufacturer's written installation recommendations.
- .2 Operation and Maintenance Manual data to include:
 - .1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.
 - .2 Technical data:
 - .1 Approved shop drawings.

- .2 Characteristic curves for automatic circuit breakers and protective devices.
- .3 Project data.
- .4 Technical description of components.
- .5 Parts lists with names and addresses of suppliers.

1.4 PROTECTION OF SYSTEMS

- .1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.
- .2 Automatic circuit breakers and protection included in:
 - .1 AC input to rectifier.
 - .2 Battery input.
 - .3 Bypass circuit input.
 - .4 Inverter output.
- .3 Surge suppressors:
 - .1 To protect system against supply voltage switching transients.
 - .2 To protect internal circuits where necessary against voltage transients.
- .4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.
- .5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.
- .6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.
- .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: Crating:
 - .1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.
 - .2 For rail or sea shipment use double layer of vapour barrier and 19 mm plywood covering.
 - .3 Subassemblies may be packed separately.

1.6 WARRANTY

- .1 For the Work of this Section 26 33 53 - Uninterruptible Power Systems Static, 12 months warranty period is extended to 60 months.

- .2 Contractor hereby warrants battery against defects in material and workmanship in accordance with GC 24, but for 20 years. This warranty is for 100% replacement for first year and prorated in equal yearly decreasing increments for remaining 19 years until expiration of warranty at end of 20 years from date of Certificate of Substantial Performance.

PART 2 **PRODUCTS**

2.1 **SYSTEM DESCRIPTION**

- .1 Standard of acceptance: APC Smart UPS 2200VA LCD Rm 2U 120V C/W Management Network Card.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Locate UPS cubicles, battery rack and battery as indicated.
- .2 Locate and install remote mode lights and alarm cabinet as indicated.
- .3 Assemble and interconnect components to provide complete UPS as specified.
- .4 Connect AC mains to main input terminal.
- .5 Connect UPS output to load.
- .6 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.2 **TESTING**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical, 26 05 10 Testing and Commissioning, and CAN/CSA-C813.1.
- .2 Provide:
 - .1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
 - .2 Dummy load adjustable to 150% of system rated output.
- .3 Notify Consultant [10] working days in advance of test date.
- .4 Tests:
 - .1 Inspection of cubicles, battery rack and battery.
 - .2 Inspection of electrical connections.
 - .3 Inspection of installation of remote mode lights and alarms.
 - .4 Demonstration of system start-up and shut-down.
 - .5 Run UPS for minimum period of [4] hours at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no AC input.

- .6 Discharge battery by operating UPS with AC mains open for specified duration of full load. Record readings of temperature of each cell.
- .7 Recharge battery automatically with full rated load on UPS for [4] hours and record readings of voltage of each cell.

3.3 START-UP

- .1 Arrange with Consultant:
 - .1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site.
 - .2 For instruction of personnel on theory, construction, installation, operation and maintenance of system per Section 26 05 12 Demonstration and Training.
- .2 Advise on:
 - .1 Expected failure rate of equipment.
 - .2 Type of expected failures.
 - .3 Estimated time between major overhauls based on 20 year equipment life.
 - .4 Estimated cost of major overhaul based on current costs and excluding travelling expenses.
 - .5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

3.4 PROTECTION

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

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)
- .7 Illuminating Engineering Society of North America (IESNA)
 - .1 LM-79 Electrical and Photometric Measurements of Solid-State Lighting Products
 - .2 LM-80 Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules.
 - .3 IESNA TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Proposed Alternates:
 - .1 All proposed alternates must be submitted for consultant review minimum 1 week prior to tender addendum cutoff date. No proposed alternates will be entertained after close of tender.
 - .2 For any proposed alternates, provide complete photometric data prepared by independent testing laboratory.
- .3 Shop Drawings:

- .1 Submit shop drawings as per Section 26 05 00 Common Work Results – Electrical.
- .2 Provide shop drawings in sufficient time to avoid any delivery delays to the project, allowing minimum 1 week for consultant review. No extras or substitutions will be allowed to expedite delivery of luminaires unless alternates are approved prior to close of tender.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 It is the contractor's responsibility to ensure timely delivery of luminaire products to the project in order to meet the project schedule. In the case that luminaire delivery will cause a delay to the project, the contractor shall be responsible for all associated delay costs to the contract as well as arrange and pay for the following:
 - .1 Supply of temporary luminaires suitable to the space prior to substantial completion and project handover. Proposed temporary luminaires shall be reviewed and approved by the consultant for suitability to the space.
 - .2 Changing out the temporary luminaires to the specified products once they arrive. This work shall be scheduled so as to cause no interruption to the occupant schedule, allowing for weekend or night work as required.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Contractor shall confirm with suppliers during the tender process that delivery timelines will meet the project schedule. Any luminaires that cannot be delivered to meet the project schedule shall be identified during the tender process, with a request for alternate submitted as per submittal section 1.3.2 above.

2.2 FINISHES

- .1 Luminaire finish and construction as indicated in luminaire schedule and to meet ULC listings and CSA certifications related to intended installation.

2.3 LUMINAIRES

- .1 As indicated in luminaire schedule.

2.4 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule and on drawings.
- .2 Not Required.

2.5 WARRANTY

- .1 Unless otherwise noted, all LED luminaires to have a 10 year material warranty on complete luminaire.

- .2 Unless otherwise noted, all other luminaire types to have a 5 year material warranty on complete luminaire except lamps.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated and as per manufacturers install guides and recommended practices. Contractor shall refer to manufacturer's recommendations in the case of any questions arising from installation methods or procedures.
- .2 Coordinate with other trades on site for the setting out of the work and ensure there are no conflicts. Any luminaires required to be relocated due to conflict with other trades will be done at the contractor's expense.
- .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .4 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .5 Provide adequate support to suit ceiling system and seismic engineer requirements.
- .6 Provide additional strut supports where required to accommodate other ceiling mounted equipment.
- .7 For suspended ceiling installations support luminaires independently of ceiling unless specifically noted otherwise and allowed by the local inspector.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install conduit to luminaires unless otherwise indicated.
 - .2 Flexible wiring may be used for final 1.5m (5') of connection to luminaires in suspended ceilings.

3.3 TESTING AND ACCEPTANCE

- .1 Test installed lighting systems in accordance with Section 26 05 00 Common Work Results Electrical and Section 26 05 10 Testing and Commissioning.

3.4 CLEANING

- .1 Clean lighting control elements, lamps fixture interiors and exposed exterior surfaces prior to Substantial completion.
- .2 All luminaire lenses and reflective surfaces are to be wiped clean and free from dust, fingerprints, and other blemishes prior to turnover of the space.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No.141, Emergency Lighting Equipment.

1.3 **SUBMITTALS**

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

1.5 **WARRANTY**

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

PART 2 **PRODUCTS**

2.1 **EQUIPMENT**

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 VAC.
- .3 Output voltage: 24 VDC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for:
 - .1 Battery Failure
 - .2 Battery Disconnected
 - .3 Charger Failure
 - .4 Lamp Failure

- .5 Service Alarm
- .6 AC Power ON
- .7 High Charge
- .10 Lamp heads: 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 9 W, minimum.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Automated Self-Test
 - .6 Battery disconnect device.
 - .7 AC input and DC output terminal blocks inside cabinet.
 - .8 Cord and plug connection for AC.
 - .9 RFI suppressors.

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 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101, Life Safety Code.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets where applicable.

PART 2 **PRODUCTS**

2.1 **SELF-POWERED UNITS**

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: cold rolled steel minimum 0.8 mm thick.
- .3 Lamps: LED 120V 50,000 hours.
 - .1 Pictogram style.
 - .2 Supply voltage: 120V, ac.
 - .3 Output voltage: 12 V dc.
 - .4 Operating time: 30 minimum.
 - .5 Recharge time: 12 hours
 - .6 Battery: sealed, maintenance free.
 - .7 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
 - .8 Solid state transfer circuit.
 - .9 Signal lights: solid state, for 'AC Power ON', 'High Charge' condition.
 - .10 Integrated emergency lighting heads where indicated on Drawings.

- .1 345 degrees horizontal and 180 degrees vertical adjustment.
- .2 Lamps shall be 6W LED.
- .11 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .12 Cabinet: finish: white.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Lamp disconnect switch.
 - .4 Test switch.
 - .5 AC/DC output terminal blocks inside cabinet.
 - .6 RFI suppressor.
 - .7 Cord and plug connection for AC power supply.

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, BC Building Code and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

- .1 American National Standards Institute
 - .1 ANSI J-STD-607-A, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA -606 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 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical

PART 2 **PRODUCTS**

2.1 **BONDING CONDUCTOR FOR TELECOMMUNICATIONS**

- .1 3/0 AWG copper conductor, green insulated FT6 marked to: ANSI J-STD-607-A.

2.2 **TELECOMMUNICATIONS BONDING BACKBONE (TBB)**

- .1 3/0 AWG copper conductor, green insulated FT6 marked to: ANSI J-STD-607-A.

2.3 WARNING LABELS

- .1 Non-metallic warning labels in English and French to: ANSI J-STD-607-A.
 - .1 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

PART 3 EXECUTION

- .1 Conduit and tray sections longer than 1 meter shall be bonded unless otherwise noted
- .2 Bonding conductor run in cable trays shall be fastened to tray twice per each mechanical section of tray.

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Install TGB where indicated on drawings.
- .2 Install 3/0 AWG copper bonding conductor from TGB as indicated on Drawings.

3.3 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.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.
- .2 Use copper compression grounding lug, 2 hole, Burndy Hy-Press or equal for connection to TGB.

3.5 BONDING TO TGB

- .1 Bond metallic raceways serving telecommunications equipment to TGB using No. 6 AWG green insulated copper conductor.
- .2 Bond equipment racks and cabinets located in equipment rooms to TGB using No. 6 AWG green insulated copper conductor.

3.6 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA -606.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 **REFERENCES**

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 **PRODUCTS**

2.1 **SYSTEM DESCRIPTION**

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2 Conduits for typical single communication outlets shall be minimum 27mm unless otherwise noted
- .3 Typical outlet boxes shall be minimum double gang, complete with single gang mudring unless otherwise noted

2.2 **MATERIAL**

- .1 Conduits: type as indicated on Drawings, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Cable trays: basket type, in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Junction boxes in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 Outlet boxes, conduit boxes size, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .5 Indoor service poles: Not Required.
- .6 Fish wire: polypropylene type.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Install empty raceway system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .2 Daisy chaining of outlets will not be accepted, system will be installed in a star topology unless noted otherwise.
- .3 Contractor must plan and measure each run of CAT cable before ordering materials and installation and alert the Departmental Representative if any run exceeds 70 meters in length. Proceed with installation of raceways for CAT runs exceeding 70 meters only if directed in writing.
- .4 All wiring shall be installed in conduit or cable tray.

3.2 **PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.
- .2 Section 27 41 05 Fibre Communications
- .3 Section 27 41 01 Local Area Network Equipment

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232, Optical Fiber Cables.
- .2 BICSI
 - .1 Telecommunications Distribution Methods Manual (TDMM) – Latest Edition.
- .3 Telecommunications Industry Association (TIA)
 - .1 TIA-568.0-D, Commercial Building Telecommunications Cabling General Requirements.
 - .2 TIA-568-C.2, Commercial Building Balanced Twisted-Pair Telecommunications Cabling and Components.
 - .3 TIA -568.3-D, Optical Fiber Cabling Components Standard.
 - .4 TIA -606-C, Administration Standards for Telecommunications Infrastructure.
 - .5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - .6 TIA-598-D, Optical Fiber Cable Color Coding.

1.3 **DEFINITIONS**

- .1 Refer to TIA -598-D, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.4 **SYSTEM DESCRIPTION**

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems as indicated on Drawings

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 FOUR-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA -568.0-D.

2.2 OUTSIDE PLANT (OSP) CABLE

- .1 Six-pair, shielded-twisted-pair (STP) cable, to: ANSI/ICEA S-86-634-2011, Category 6 (Cat 6) to: TIA -568.0-D.

2.3 WORK AREA UTP 2-PAIR MODULAR JACK

- .1 Six-position modular jack ("RJ-11")
 - .1 In self-contained surface-mount box,
 - .2 Mounted in compatible single gang faceplate, flush entry, 1 jack position per faceplate.

2.4 WORK AREA UTP 4-PAIR MODULAR JACK

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA -568.0-D
 - .1 In self-contained surface-mount box,
 - .2 Mounted in compatible single gang faceplate, flush entry, 2 jack positions per faceplate.
 - .3 Where more than two outlets are shown adjacent each other, multi-gang boxes with more than four outlets may be used.
- .2 Multi-user telecommunications outlet assembly (MUTOA), number of ports as indicated on Drawings, each port equipped with field installed "RJ-45" jacks, type T568A Category 6 to: TIA-568.

2.5 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 Standard of Acceptance: PANDUIT DP246X88TGY or PANDUIT DP486X88TGY CAT6A Patch Panel Kit. Quantity of ports as indicated on Drawings.

2.6 UTP PATCH CORDS

- .1 Factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack. Category 6, 4 pairs. to: TIA -568.0-D.

- .2 Length to suite.

2.7 UTP WORK AREA CORDS

- .1 3 metres long, each end equipped with "RJ-45" Category 6 to: TIA-568.0-D.

2.8 OPTICAL-FIBER CABLE

- .1 Not Required.

PART 3 EXECUTION

- .1 Installation of cabling, terminations, and hardware shall be conducted in compliance with the best practices identified in the BICSI Telecommunications Distribution Methods Manual (TDMM).
- .2 All cabling runs must maintain minimum separation from sources of EMI interference including line voltage, high voltage, ballast/switching power supplies, and transformers. Cables found to be in conflict with sources of EMI will be required to be re-routed at no cost to the Departmental Representative.
- .3 Cables must be installed as per manufacturer's recommendations, pull strength must not exceed the maximum allowable strength.
- .4 Cables found to have been superficially damaged (kinked or torn jackets, etc.) will be required to be replaced at no cost to the Departmental Representative even if the link test meets minimum standards.
- .5 Cable dressing and bundling shall be made using Velcro straps. Use of zip ties or other non-approved restraints shall not be allowed. Any installed non-standard cable bundling products shall be removed, the cables inspected for damage, and if necessary replaced.
- .6 Prior to installing cables, contractor must review raceway for the run and allow to provide drop outs, supporting waterfalls, grommets, and any other reasonable miscellaneous cable restraints/support hardware as needed.
- .7 Cable support products such as jhooks and other supports shall be manufactured specifically for the purpose of supporting communications cable. Site fabricated frames or other supports shall be allowed only as noted in writing.
- .8 Maximum cable lengths are not to exceed 90 meters for CAT cable (including patch cords in communication room and at equipment end). Fiber lengths are not to exceed those recommended by the manufacturer. Contractor must plan installation routing and alert the Departmental Representative if any links are found to exceed or be within 3 meters of maximum distance. Planning must take place prior to starting rough-in or preparatory cutting/coring work. No extras will be allowed for revision of raceway or preparatory cutting/coring installation that was not coordinated before installation began.

3.2 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA-606-C.
- .2 Consolidation points shall not be used unless explicitly indicated; all cabling shall be typically home run. If indicated, install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA -606-C.

3.3 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits or cable trays from telecommunication rooms to consolidation point and to individual work-area jacks. Identify and label as indicated to: TIA -606-C.
 - .1 J hooks: not permitted
- .2 Terminate horizontal cables in telecommunications room, consolidation points, and individual work-area jacks.
 - .1 Identify and label as indicated to: TIA -606-C.
- .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.

3.4 INSTALLATION OF BACKBONE CABLES

- .1 Install backbone cables from each telecommunications room to main terminal/equipment rooms (MT/ER) as indicated and according to manufacturers' instructions.
 - .1 Identify and label as indicated to: TIA -606-C.

3.5 INSTALLATION OF EQUIPMENT CABLES

- .1 Install equipment cables from equipment patch panel as indicated.
 - .1 Identify and label as indicated to: TIA -606-C.

3.6 IMPLEMENT CROSS-CONNECTIONS

- .1
- .2 Cross-connections by others.

3.7 LABELLING STANDARDS

- .1 Contractor shall label network equipment and data drops using the site-specific labelling standard. Contractor shall confirm standard with Departmental Representative prior to commencing construction.

3.8 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide complete record of results as electronic record on USB memory stick.
 - .1 Perform tests 100% of cross-connected data horizontal cabling to:
 - .1 Category 5e using certified level IIe tester to: TIA -568-D.
 - .2 Category 6 using certified level III tester to: TIA -568-D .
 - .2 Tests for CAT 6 cables shall include: wiremap, propagation delay, delay skew, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, and PSACR.
 - .1 Provide report summary identifying links with pass, fail, conditional pass, and conditional fail.
 - .2 Failing or conditionally failing links must be corrected and re-tested at the Contractor's expense.
 - .3 Conditional Pass links must be highlighted and will, at the discretion of Departmental Representative, be required to be corrected and re-tested at the Contractor's expense.
- .2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as electronic record on USB memory stick.
 - .1 Perform tests for Permanent Link on 4-pair cables:
 - .1 Category 5e using certified level IIe tester to: TIA -568-D.
 - .2 Category 6 using certified level III tester to: TIA -568-D .
 - .2 Perform Wire Map tests on multi-pair UTP cables to: TIA -568-D.
- .3 Provide record of results as electronic record on USB memory stick to: TIA/TSB-140.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.
- .2 It is the responsibility of the electrical contractor and all electrical subtrades to inform themselves of all door hardware coordination issues including card readers, power supply and transfer and necessary conduit and cabling with all door hardware requirements of the project.
- .3 Access control contractor shall refer to and coordinate with the architectural door schedule, and door hardware specifications for access control and division 08 hardware supplier and subtrades.

1.2 **REFERENCES**

- .1 Reference Standards:
 - .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S301, Standard for Signal Receiving Centre Burglar Alarm System and Operations
 - .2 CAN/ULC-S302, Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults.
 - .3 CAN/ULC-S304, Signal Receiving Centre and Premise Burglar Alarm Control Units.
 - .4 CAN/ULC-S310, Installation and Classification of Residential Burglar Alarm Systems.
 - .5 ULC-S318, Standard for Power Supplies for Burglar Alarm Systems.
 - .6 ULC-C634, Guide for the Investigation of Connectors and Switches for Use with Burglar Alarm Systems.
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 294, Access Control System Units.
 - .2 UL 603, Power Supplies for Use with Burglar Alarm Systems.
 - .3 UL 681, Installation and Classification of Burglar and Holdup Alarm Systems.
 - .4 UL 827, Central-Station Alarm Services.
 - .5 UL 1023, Household Burglar Alarm System Units.
 - .6 UL 1076, Safety for Proprietary Burglar Alarm Units and Systems.
 - .7 UL 1641, Safety for Installation and Classification of Residential Burglar Alarm Systems.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
 - .1 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
 - .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.
 - .2 Shop drawings to indicate project layout, including details.
 - .1 Shop drawings to indicate, mounting heights and locations, wiring diagrams.
 - .2 Submit wiring diagrams.
 - .3 Submit complete equipment list.
 - .3 Samples:
 - .1 Submit for review and acceptance of each unit if required.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit ULC/UL Product Safety Certificates.
 - .2 Submit verification Certificate that service company is ULC/UL List alarm service company.
 - .3 Submit verification Certificate that monitoring facility is ULC/UL "Listed central station".
 - .4 Submit verification Certificate that security access system is "Certified alarm system".
 - .5 Test and Evaluation Reports:
 - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - .7 Operation and Maintenance Data: submit operation and maintenance data for access controls and equipment for incorporation into manual.
 - .1 Include:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.

.6 Cleaning instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00
Common Work Results – Electrical.

1.5 WARRANTY

.1 Refer to contract general conditions.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Provide door controller modules and interconnect as required.
- .2 Existing system is Kantech with IOProx Card Readers.
- .3 Provide the following equipment to match the existing system:
 - .1 Door controllers shall be Kantech KT-400
 - .2 Provide door controllers complete in enclosure with power supply and battery backup for a minimum of four (4) hours.
- .4 Provide card readers, request to exit motion detectors, and door contacts as indicated on Drawings..

2.2 CARD READERS

.1 Kantech Multi-Technology readers.

2.3 REQUEST TO EXIT DEVICE

.1 Standard of Acceptance: T-Rex

2.4 SYSTEM

- .1 Connect door controllers to Shared Services Canada network.
- .2 Contractor shall be responsible for programming of new door controllers to integrate into the existing access control system as follows:
 - .1 Data Room: door shall remain locked at all times. When a valid card is presented the door shall unlatch.
 - .2 Shared Services Room: door shall remain locked at all times. When a valid card is presented the door shall unlatch.
- .3 System Accessories:
 - .1 Door strike: as coordinated with door hardware supplier, UL approved complete with mounting hardware.
 - .2 Request to exit motion detector device:
 - .1 Infrared detection.

- .2 Continuous low-voltage operation.
- .3 Fitted with indicator light.
- .4 Integrated with local audio alarm (electronic buzzer).
- .5 Adjustable coverage.
- .3 Power supplies:
 - .1 Continuous low-voltage operation output.
 - .2 Equipped with secondary protection for each output.
 - .3 Individual outputs for connection of devices.
 - .4 AC power failure output.
 - .5 DC power failure output and low battery output.
 - .6 Fitted with tamper contact.
 - .7 Wall mounted cabinet with locked door complete with [2] keys.
- .4 Voltage: 24 volt DC.

PART 3 EXECUTION

.1 .

3.2 INSTALLATION

- .1 Install security access systems and components in accordance with CAN/ULC-S302, CAN/ULC-S310, UL294, and UL 681.
- .2 Extend wiring from nearest existing door controllers to new controllers or provide new network connections as indicated on drawings.
- .3 Install components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .1 Install panels, intrusion detection system and components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .2 Install components secure to walls, ceilings or other substrates.
- .3 Install required boxes in inconspicuous accessible locations.
- .4 Conceal conduit and wiring.
- .5 Coordinate with Shared Services Canada for integration of new door controllers into existing network.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer Services:
 - .1 Manufacturer of products, supplied under this Section, to review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services:

- .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
- .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .2 Site Acceptance Testing:
 - .1 Demonstrate operation of all card access doors to Departmental Representative.

3.4 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 31 23 10-Excavating, Trenching and Backfilling.
- .2 Section 32 11 16-Granular Sub-Base.
- .3 Section 32 11 23-Aggregate Base Courses.
- .4 Section 33 31 13-Public Sanitary Utility Sewerage Piping.
- .5 Section 33 41 00-Storm Utility Drainage Piping.

1.2 References

- .1 ASTM; AWWA; CAN – As specified in the contract document

1.3 Samples

- .1 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.4 Waste Management and Disposal

- .1 Divert unused granular materials from landfill to local facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
 - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .3 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Light weight aggregate, including slag and expanded shale.

2.2 Source Quality Control

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.
- .2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

- .3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 EXECUTION

3.1 Preparation

- .1 Topsoil stripping
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as directed by Departmental Representative after area has been cleared of brush and grasses and removed from site.
 - .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
 - .4 Dispose of topsoil to location as indicated off site.
- .2 Aggregate source preparation
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.
 - .2 When excavation is completed dress sides of excavation in accordance with the Geotechnical Report, and provide drains or ditches as required to prevent surface standing water.
 - .3 Trim off and dress slopes of waste material piles and leave site in neat condition.
- .3 Processing
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.
 - .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .4 Handling
 - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .5 Stockpiling
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.

3.2 Cleaning

- .1 Leave aggregate stockpile site in tidy, well-drained condition, free of standing

surface water.

- .2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 31 23 17-Rock Removal.
- .3 Section 33 05 13-Manholes and Catch Basin Structures.
- .4 Section 33 31 13-Public Sanitary Utility Sewerage Piping.
- .5 Section 33 41 00-Storm Utility Drainage Piping.

1.2 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)(2,700 kN-m/m³).
 - .6 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .3 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 Definitions

- .1 Excavation classes: one class of excavation will be recognized; common excavation.
 - .1 Rock : solid material in excess of 1.00m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 1.0m³ bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for

use in top dressing, landscaping and seeding.

- .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.
 - .2 Coarse grained soils containing more than 10 % by mass passing 0.075 mm sieve.
 - .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 Quality Assurance

- .1 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.
- .2 Keep design and supporting data on site.
- .3 Engage services of qualified professional Engineer who is registered or licensed in Province of BC, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .4 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

1.5 Waste Management and Disposal

- .1 Divert excess materials from landfill to local facility for reuse as directed by Departmental Representative.

1.6 Existing Conditions

- .1 Buried services:
 - .1 Before commencing work establish location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

- .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
- .5 Prior to beginning excavation Work, notify applicable Departmental Representative, establish location and state of use of buried utilities and structures.
- .6 Confirm locations of buried utilities by careful soil hydrovac methods.
- .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
- .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing/re-routing.
- .9 Record location of maintained, re-routed and abandoned underground lines.
- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.
 - .4 Restore roadway to existing conditions or better upon completion.

PART 2 PRODUCTS

2.1 Materials

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials and the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
- .2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse or other deleterious materials.

PART 3 EXECUTION

3.1 Temporary Erosion and Sedimentation Control

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 Site Preparation

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.3 Preparation/Protection

- .1 Protect existing features.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

3.4 Stripping of Topsoil

- .1 Begin topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Departmental Representative.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil off site.

3.5 Stockpiling

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 Dewatering and Heave Prevention

- .1 Riprap and headwall installation are to be done in dry conditions.
- .2 Keep excavations free of water while Work is in progress.
- .3 Provide for Departmental Representative's review details of proposed dewatering.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.7 Excavation

- .1 Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Remove concrete, masonry, paving, walks demolished foundations and rubble and other obstructions encountered during excavation.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .12 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected Standard Proctor maximum dry density.
- .13 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.8 Bedding and Surround of Underground Services

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Place bedding and surround material in unfrozen condition.

3.9 Backfilling

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.
- .5 Place backfill material in uniform layers not exceeding 300mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Backfilling around installations:
 - .1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.30 m.

3.10 Restoration

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.
- .3 Reinstall lawns to elevation which existed before excavation.
- .4 Reinstall pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 31 23 10-Excavating, Trenching and Backfilling.

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .6 ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .7 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .8 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

1.3 Waste Management and Disposal

- .1 Divert unused granular material from landfill to local facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.
 - .3 Table

<u>Sieve Designation</u>	<u>% Passing</u>
100 mm	--
75 mm	100
50 mm	60-100
37.5 mm	--
25 mm	35-80
19 mm	--
12.5 mm	--
9.5 mm	26-60
4.75 mm	20-40
2.00 mm	15-30
0.425 mm	5-28
0.180 mm	--
0.075 mm	0-8

- .4 Other Properties as follows:
 - .1 Liquid Limit: to ASTM D 4318, Maximum 25.
 - .2 Plasticity Index: to ASTM D 4318, Maximum 6.
 - .3 Los Angeles degradation: to ASTM C 131. Max% Loss by mass:
40.

PART 3 EXECUTION

3.1 Placing

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 Place material to full width in uniform layers not exceeding 300mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 Compaction

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-

base.

- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 Site Tolerances

- .1 Finished sub-base surface to be within 15mm of elevation as indicated but not uniformly high or low.

3.4 Protection

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 31 23 10-Excavating, Trenching and Backfilling.
- .3 Section 32 11 16-Granular Sub-Base.

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D 1557-[00], Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .6 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .7 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

1.3 Waste Management and Disposal

- .1 Divert unused granular material from landfill to local facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel.

- .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

- .1 Gradation Method # 1 to:

<u>Sieve Designation</u>	<u>% Passing</u>
100 mm	--
75 mm	--
50 mm	--
37.5 mm	--
25 mm	--
19 mm	100
12.5 mm	70-100
9.5 mm	--
4.75 mm	40-70
2.00 mm	23-50
0.425 mm	7-25
0.180 mm	--
0.075 mm	3-8

PART 3 EXECUTION

3.1 Sequence of Operation

- .1 Place granular base after sub-base surface is inspected and approved by Departmental Representative.
- .2 Placing
- .1 Construct granular base to depth and grade in areas indicated.
- .2 Ensure no frozen material is placed.
- .3 Place material only on clean unfrozen surface, free from snow and ice.
- .4 Begin spreading base material on crown line or on high side of one-way slope.
- .5 Place material using methods which do not lead to segregation or degradation of aggregate.
- .6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .7 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment
- .1 Compaction equipment to be capable of obtaining required material densities.

- .4 Compacting
 - .1 Compact to density not less than 95% Modified Proctor Density.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling
 - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730mm.
 - .2 Obtain approval from Departmental Representative to use non standard proof rolling equipment.
 - .3 Proof roll at level in granular base as indicated. If use of non standard proof rolling equipment is approved, Departmental Representative to determine level of proof rolling.
 - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with Section 32 11 16 - Granular Sub-Base.
 - .3 Replace sub-base material and compact in accordance with Section 32 11 16 - Granular Sub-base.
 - .4 Replace base material and compact in accordance with this Section.
 - .6 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Departmental Representative and replace with new materials in accordance with Section 32 11 16 - Granular Sub-base and this section at no extra cost.

3.2 Site Tolerances

- .1 Finished base surface to be within plus or minus 10mm of established grade and cross section but not uniformly high or low.

3.3 Protection

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Materials and application of asphalt prime to granular base surface prior to asphalt paving.

1.2 Related Sections

- .1 Section 32 12 16-Asphalt Paving.

1.3 References

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 140, Standard Practice for Sampling Bituminous Materials.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.1, Cutback Asphalts for Road Purposes.
 - .2 CAN/CGSB-16.2, Emulsified Asphalts, Anionic Type, for Road Purposes.

1.4 Quality Assurance

- .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials to ASTM D 140.
- .2 Provide, maintain and restore asphalt storage area.

1.6 Waste Management and Disposal

- .1 Divert unused asphalt materials from landfill to local facility approved by Departmental Representative.
- .2 Divert unused aggregate materials from landfill to local facility approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Material

- .1 Asphalt material: to CAN/CGSB-16.1 grade: RM-20 or CAN/CGSB-16.2 grade: SS-1.
- .2 Sand blotter: clean granular material passing 4.75mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

2.2 Equipment

- .1 Pressure distributor to be :
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.
 - .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distributed in uniform spray without atomization at temperature required.
 - .2 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified

rate.

- .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment.
- .8 Cleaned if previously used with incompatible asphalt material.

PART 3 EXECUTION

3.1 Application

- .1 Obtain Departmental Representative's approval of granular base surface before applying asphalt prime.
- .2 Cutback asphalt:
 - .1 Heat asphalt prime to [between 60 and 70 degrees C for pumping and spraying.
 - .2 Apply asphalt prime to granular base at rate as directed by Departmental Representative, but not to exceed 2 L/m².
 - .3 Apply on dry surface unless otherwise directed by Departmental Representative.
- .3 Anionic emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
 - .2 Mix thoroughly by pumping or other method approved by Departmental Representative.
 - .3 Apply diluted asphalt emulsion at rate directed by Departmental Representative, but do not exceed 5 L/m².
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .4 Apply asphalt prime only on unfrozen surface.
- .5 Do not apply prime when air temperature is less than 5 degrees C or when rain is forecast within 2 hours.
- .6 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .7 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .8 Prevent overlap at junction of applications.
- .9 Do not prime surfaces that will be visible when paving is complete.
- .10 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .11 Keep traffic off primed areas until asphalt prime has cured.

.12 Permit prime to cure before placing asphalt paving.

3.2 Use of Sand Blotter

- .1 If asphalt prime fails to penetrate within 24 hours, spread sand blotter material in amounts required to absorb excess material.
- .2 Allow sufficient time for excess prime to be absorbed as directed by Departmental Representative.
- .3 Apply second application of sand blotter as required.
- .4 Sweep and remove excess blotter material.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Materials and installation for asphalt concrete paving for roads and airport runways.

1.2 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 32 12 14-Asphalt Prime Coats.
- .3 Section 32 12 15-Asphalt Tack Coats.

1.3 Measurement Procedures

- .1 All work included in this section shall be included in the lump sum bid for all materials, equipment and labour for the scope of work shown on the plans and specifications.

1.4 References

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245, Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS2 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C 117, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 123, Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C 127, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C 128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .8 ASTM C 207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - .9 ASTM D 995, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
 - .10 ASTM D 2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - .11 ASTM D 3203, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

- .12 ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-16.3, Asphalt Cements for Road Purposes.

1.5 Product Data

- .1 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
- .2 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 4 weeks prior to beginning Work.

1.6 Delivery, Storage and Handling

- .1 Deliver and stockpile aggregates in accordance with Section 31 05 16 - Aggregate Materials.

1.7 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Divert unused aggregate materials from landfill to facility for reuse.
- .4 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 PRODUCTS

2.1 Materials

- .1 Asphalt cement: to CAN/CGSB-16.3, grade: 80-100.
- .2 Reclaimed asphalt pavement:
 - .1 Crushed and screened so that 100% of RAP material passes 50 mm screen before mixing.
- .3 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials: General following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117.

.3 Table

Sieve Designation	Percent Passing	
	Lower Course	Upper Course #1
25.0mm	--	--
19.0mm	100	--
12.5mm	84 - 99	100
9.5mm	73 - 88	--
4.75mm	50 - 68	55 - 75
2.36mm	35 - 55	38 - 58
1.18mm	27 - 46	28 - 47
0.600mm	18 - 36	20 - 36
0.300mm	10 - 26	10 - 26
0.150mm	4 - 17	4 - 17
0.075mm	3 - 8	3 - 8

- .4 Coarse aggregate: aggregate retained on 4.75mm sieve and fine aggregate is aggregate passing 4.75mm sieve when tested to ASTM C 136.
- .5 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75mm sieve and stockpile separately from coarse aggregate.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Sand equivalent: ASTM D 2419 Min: 40.
- .8 Magnesium Sulphate soundness: to ASTM C 88 Max% loss by mass:
- .1 Coarse aggregate surface course: 15%.
 - .2 Coarse aggregate lower course: 15%.
 - .3 Fine aggregate, surface course: 18%.
 - .4 Fine aggregate, lower course: 18%.
- .9 Los Angeles degradation: Grading B, to ASTM C 131 Max % loss by mass:
- .1 Coarse aggregate, surface course: 25%
 - .2 Coarse aggregate, lower course: 35%.
- .10 Absorption: to ASTM C 127 Max % by mass:
- .1 Coarse aggregate, surface course: 1.75%.
 - .2 Coarse aggregate, lower course: 2.00%.
- .11 Loss by washing: to ASTM C 117 Max % passing 0.075 mm sieve:
- .1 Coarse aggregate, surface course: 1.5
 - .2 Coarse aggregate, lower course: 2.0
- .12 Flat and elongated particles: to ASTM D 4791, (with length to thickness ratio greater than 5): Max% by mass:
- .1 Coarse aggregate, surface course: 10%.

- .2 Coarse aggregate, lower course: 10%.
- .13 Crushed fragments: at least 60% of particles by mass within each of following sieve designation ranges, to have at least 2 freshly fractured face. Material to be divided into ranges, using methods of ASTM C 136.

Passing		Retained on
[25] mm	to	12.5mm
[12.5] mm	to	4.75mm
- .14 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .4 Mineral filler:
 - .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
 - .3 Mineral filler to be dry and free flowing when added to aggregate.
- .5 Water: to approval of Departmental Representative.

2.2 Equipment

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Minimum drum diameter: 1200mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5mm for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass not less than 12 kg and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative may be used instead of tamping irons.
 - .3 Straight edges, 3.0m in length, to test finished surface.

2.3 Mix Design

- .1 Mix design to be developed by testing laboratory approved by Departmental Representative.
- .2 Mix to contain maximum 20% by mass of RAP. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.
- .3 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: 75.
 - .2 Mix physical requirements:

Property		Pavement Course	
Marshall Stability at 60°C	kN min	6.4	Lower course
		5.5	Upper Course
Flow Value	mm	2-4	
Air Voids in Mixture	%	3-6	Lower course
		3-5	Upper course
Voids in Mineral Aggregate	% min	13	Lower course 1
		14	Lower course 2
		14	Upper course 1
		15	Upper course 2
Index of Retained Stability	% min	75	

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to ASTM D1559.
- .4 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula to be reviewed by Departmental Representative.

PART 3 EXECUTION

3.1 Plant and Mixing Requirements

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D 995.
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Do not load frozen materials into bins.
 - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
 - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .5 Before mixing, dry aggregates to moisture content not greater than 1% by mass or to lesser moisture content if required to meet mix design requirements.
 - .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
 - .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
 - .8 Heat asphalt cement and aggregate to mixing temperature directed by

- Departmental Representative. Do not heat asphalt cement above 160 degrees C.
- .9 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
 - .10 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Do not alter mixing time unless directed by Departmental Representative.
 - .11 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5mm scalping screen on cold feed to remove oversized pieces of RAP.
 - .2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti rollback device to prevent material from sliding backward on feed belt.
 - .3 Combine RAP and new aggregates in proportions as directed by Departmental Representative. Dry mix thoroughly, until uniform temperature within plus or minus 5 degrees C of mix temperature, as directed by Departmental Representative Consultant is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dried mix material is above 160 degrees C.
 - .2 Dryer drum mixing plant:
 - .1 To ASTM D 995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Where RAP is to be incorporated into mix, dryer drum mixer is to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180 degrees C.
 - .5 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .6 Meter total flow of aggregate and RAP by an electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate RAP and asphalt entering mixer remain constant.
 - .7 Provide for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.
 - .8 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved. Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time. Difference between this

- value and amount shown by plant computer system to differ by not more than plus or minus 2%.
- .9 Make provision for conveniently sampling full flow of materials from cold feed.
 - .10 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .11 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
 - .12 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each [week] [day].
 - .13 Mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.5%.
- .3 Temporary storage of hot mix:
- .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 12 hour.
- .4 Mixing tolerances:
- .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

4.75 mm sieve and		
larger	5.5	
2.00 mm sieve		4.5
0.425 mm sieve	3.5	
0.180 mm sieve	2.5	
0.075 mm sieve	1.5	
 - .2 Permissible variation of asphalt cement from job mix: 0.3%.
 - .3 Permissible variation of mix temperature at discharge from plant: 5 degrees C.
- .5 Addition of anti-stripping agent:
- .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime prior to entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.
 - .5 Add water to aggregate prior to entering pug mill.
 - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.

3.2 Transportation of Mix

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, or non-petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.
- .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation. Do not dribble mix into trucks.
- .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 125 degrees C.

3.3 Placing

- .1 Obtain Departmental Representative's approval of base and existing surface and tack coat and prime coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as directed by Departmental Representative.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is above 5 degrees C.
 - .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as follows:
 - .1 Levelling courses to thicknesses required but not exceeding 100mm.
 - .2 Lower course in maximum of layers of 50mm each.
 - .3 Surface course in layers of maximum 50mm each.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Spread and strike off mixture with self propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings. Departmental Representative to establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.

- .6 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
- .7 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly. Do not broadcast material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt. Control temperature to avoid burning material. Do not use tools at higher temperature than temperature of mix being placed.

3.4 Compacting

- .1 Roll asphalt continuously to density not less than 97% of 75 blow Marshall density to ASTM D1559 with no individual test less than 95%. Contractor to provide test reports from an independent testing agency to Department Representative indicating acceptable densities have been achieved.
- .2 General:
 - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 8 km/h for finish rolling.
 - .4 Use static compaction for levelling coarse less than 25 mm thick.
 - .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .6 Overlap successive passes of roller by minimum of 200mm and vary pass lengths.
 - .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .10 After traverse and longitudinal joints and outside edge have been compacted, start

rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.

- .11 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
- .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.

3.5 Joints

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint cannot be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by 100mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joints as indicated.
- .5 Construct butt joints as indicated.

3.6 Finish Tolerances

- .1 Finished asphalt surface to be within 6mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 6mm when checked with 3 m straight edge placed in any direction.

3.7 Defective Work

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 32 11 16-Granular Sub-Base.
- .2 Section 32 11 23-Aggregate Base Courses.

1.2 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 260, Standard Specification for Boiled Linseed Oil.
 - .4 ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-3.3, Kerosene, Amend. No. 1, National Standard of Canada.
 - .2 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

PART 2 PRODUCTS

2.1 Materials

- .1 Concrete mixes and materials: in accordance with Cast-in-Place Concrete.
- .2 Joint filler and Curing Compound: in accordance with Cast-in-Place Concrete.
- .3 Granular base: material to Section 31 05 16 - Aggregate Materials
- .4 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .5 Fill material: to Section 31 05 16 - Aggregate Materials

PART 3 EXECUTION

3.1 Grade Preparation

- .1 Do grade preparation work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

3.2 Granular Base

- .1 Obtain Departmental Representative's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base in maximum 150 mm layers to at least 95% Modified Proctor Density.

3.3 Concrete

- .1 Obtain Departmental Representative's approval of granular base prior to placing concrete.
- .2 Do concrete work in accordance with Cast-in-Place Concrete.
- .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2mm deep, by drawing broom in direction normal to centre line.
- .4 Provide edging as indicated with 10mm radius edging tool.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.

3.4 Tolerances

- .1 Finish surfaces to within 6mm in 6m as measured with 6m straightedge placed on surface.

3.5 Expansion and Contraction Joints

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 3 m.
- .2 Install expansion joints at intervals 9 m.
- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 Isolation Joints

- .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints in accordance with Section Cast-in-Place Concrete.
- .3 Seal isolation joints with sealant approved by Departmental Representative.

3.7 Curing

- .1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 7 days after placing, or sealing moisture in by curing compound as directed by Departmental Representative.
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.8 Backfill

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material as directed by Departmental Representative.
 - .1 Compact and shape to required contours as directed by Departmental Representative.

3.9 Cleaning

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

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 31 23 10-Excavating, Trenching and Backfilling.
- .2 Section 33 31 13-Public Sanitary Utility Sewerage Piping.
- .3 Section 33 41 00-Storm utility Drainage Piping.

1.2 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 48/A 48M, Standard Specification for Gray Iron Castings.
 - .2 ASTM C 117, Standard Test Method for Materials Finer than 75- μm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM C 139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .5 ASTM C 478M, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - .6 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
 - .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A3002, Masonry and Mortar Cement.
 - .3 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .4 CAN/CSA-G30.18, Billet Steel Bars for Concrete Reinforcement.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 Delivery, Storage And Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's

written instructions.

PART 2 PRODUCTS

2.1 Materials

- .1 Cast-in-place concrete:
 - .1 Cement: to CAN/CSA-A3001, Type GU 50.
 - .2 Concrete mix design to produce 30 MPa minimum compressive strength at 28 days and containing 25mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1.
 - .1 Air entrainment to CAN/CSA-A23.1.
- .2 Precast manhole units: to ASTM C 478M, circular or oval.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
- .3 Precast catch basin sections: to ASTM C478M.
- .4 Joints: made watertight using rubber rings to ASTM C443 or cement mortar.
- .5 Mortar:
 - .1 Aggregate: to CSA A82.56.
 - .2 Masonry Cement: to CAN/CSA-A8.
- .6 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.
 - .1 Rungs to be safety pattern (drop step type).
- .7 Adjusting rings: to ASTM C 478.
- .8 Concrete Brick: to CAN3-A165 Series.
- .9 Drop manhole pipe: same as sewer pipe.
- .10 Galvanized iron sheet: approximately 2 mm thick.
- .11 Steel gratings, I-beams and fasteners: as indicated.
- .12 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .2 Cast iron manhole & catchbasin frames and covers must conform to ASTM A48 and be designed to withstand H2O loading.
 - .1 Must bear manufacturer identification on castings.
- .13 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials.
- .14 Unshrinkable fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

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 Excavation And Backfill

- .1 Excavate and backfill in accordance with Section 31 23 10 - Excavating Trenching and Backfilling and as indicated.

3.3 Installation

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
- .3 Set precast concrete base on 100 mm minimum of granular bedding compacted to 95%. Modified proctor density in compliance with ASTM D1557.
- .4 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Departmental Representative's approval rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.
- .5 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.75 times diameter of sewer.
 - .2 Slope adjacent floor at 1 in 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .6 Compact granular backfill to 95% Modified Proctor Density.
- .7 Place unshrinkable backfill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
- .8 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .9 Set frame and cover to required elevation on no more than three courses of

brick.

- .1 Make brick joints and join brick to frame with cement mortar.
- .2 Parge and make smooth and watertight.
- .10 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .11 Install safety platforms in manholes having depth of 6 m or greater, as indicated.

3.4 Adjusting Tops Of Existing Units

- .1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.
- .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 300mm use standard manhole brick, moduloc or grade rings.
- .3 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
 - .4 Install additional manhole ladder rungs in adjusted portion of units as required.
 - .5 Re-use existing gratings, frames and I-beams.

3.5 Sealing Over Existing Units

- .1 Fill with material approved by Departmental Representative.

3.6 Field Quality Control

- .1 Leakage Test:
- .2 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer manhole and fill manhole with water.
- .3 Leakage not to exceed 0.3% per hour of volume of manhole.
- .4 If permissible leakage is exceeded, correct defects.
- .5 Repeat until approved by Departmental Representative.
- .6 Departmental Representative will issue Test Certificate for each manhole

passing test.

3.7 Cleaning

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

END OF SECTION

PART 1 – GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures].
.2 Section 01 78 00 - Closeout Submittals.
.3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
.4 Section 03 20 00 - Concrete Reinforcing.
.5 Section 03 30 00 - Cast-in-Place Concrete.
- 1.3 REFERENCES .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
.1 ANSI/AWWA B300-[99], Hypochlorites.
.2 ANSI/AWWA C153/A21.53-11, Ductile-Iron Compact Fittings for Water Service.
.3 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service
.4 ANSI/AWWA C651-14, Disinfecting Water Mains.
.5 ANSI/AWWA C800-12, Underground Service Line Valves and Fittings
.6 ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 60 Inch (100 mm - 1200 mm)
.2 American Society for Testing and Materials International, (ASTM)
.3 American Water Works Association (AWWA)/Manual of Practice
.1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
.4 Canadian General Standards Board (CGSB)
.5 Canadian Standards Association (CSA International)
- 1.4 SUBMITTALS .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit complete construction schedule for water mains. Include method for installation of water main.

- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Contractor to provide to the Department Representative for approval 1 week prior to start of laying pipe the results of a sieve analysis of the proposed bedding materials.
- .5 Submit manufacturer's pipe certification
- .6 Pipe certification to be on pipe.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with the Canadian Environmental Protection Act (CEPA), Transportation of Dangerous Good Act (TDGA), Regional and Municipal regulations.
- .4 Ensure emptied containers are sealed and stored safely.
- .5 Divert unused materials from landfill to metal recycling facility.
- .6 Divert unused concrete materials from landfill to local facility.
- .7 Divert unused aggregate materials from landfill to facility for reuse.
- .8 Dispose of unused disinfection material at official hazardous material collections site.
- .9 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .10 Fold up metal banding, flatten and place in designated area for recycling.

- 1.7 SCHEDULING OF WORK
- .1 Schedule Work to minimize interruptions to existing services.
 - .2 Submit schedule of expected interruptions to Department Representative for approval and adhere to interruption schedule as approved by Department Representative.
 - .3 Notify Department Representative a minimum of 48 h in advance of interruption in service.
 - .4 Do not interrupt water service for more than 4 hours.
 - .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
 - .6 Provide "Out of Service" sign on hydrant not in use.
 - .7 Advise local police department of anticipated interference with movement of traffic.

PART 2 - PRODUCTS

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end
 - .1 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket [coupling].
 - .2 Ductile Iron fittings: to ANSI/AWWA C153/A21.53-06.

2.2 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body, bronze mounted valves with non-rising stems, suitable for 1 Pa with mechanical, flanged, push-on, grooved type joints.
- .3 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.
 - .1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for [2] MPa working pressure.
 - .2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.
 - .3 Valve complete with surge check unit.
 - .4 Ends to be flanged to ANSI/AWWA.

2.3 TRACER WIRE

- .1 Direct Burial #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt

rating.

- .2 Tracer Box shall include:
 - .1 Tube material shall be of high grade ABS, or equivalent rigid plastic that meets or exceeds ASTM D-1788, Type 1 requirements.
 - .2 Lid material shall be of cast iron or ductile iron. Tensile strength or ductility of such material shall be equal or superior to hi-tensile cast iron ASTM A126-B requirements.
 - .3 Lid-locking bolt material shall be made of aluminum material equal or superior to ASTM B253.
 - .4 Lid-locking mechanism material shall be made of plastic to meet or exceed ASTM A126-B requirements.
 - .5 Box shall be designed to be easily detected by magnetic and electronic locators even when box is covered by a minimum of 100mm of soil, sod and / or paving material.
 - .6 A magnet shall be securely attached at the top of the upper tube of the box for locating purposes.

2.4 VALVE CHAMBERS

- .1 Concrete and reinforcing steel to Section 03 30 00 - Cast-in-Place Concrete and Section 03 20 00 - Concrete Reinforcing.
- .2 Precast concrete sections to ASTM C478M. Cast ladder rungs integral with unit; field installation not permitted.
- .3 Valve chamber frames and covers:
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU" .
- .5 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CAN/CSA-G30.18, hot-dipped galvanized after fabrication to CAN/CSA-G164. Rungs to be safety pattern.

2.5 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B 88M type K, annealed.
- .2 Polyethylene pressure pipe:
 - .1 To CSA-B137.1, type PE, series 160, ASTM F714, Type PE, series DR 11.
 - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE, series 250.
- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 Polyethylene pipe joints: thermal butt fusion welded
- .5 Brass corporation stops: compression type having threads to ANSI/AWWA C800.
- .6 Brass inverted key-type curb stops: compression type with

drains.

- .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
- .2 Top of cast iron box marked "WATER"/"EAU".

.7 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.

.8 Service connections for PVC pipe:

- .1 Service connections less than 100 mm: Corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
- .2 Service connections 100 mm and over: Use tee fitting or tapping valve and sleeve.

.9 Bronze type service clamps: for PVC pipe service connections.

- .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
- .2 Clamps to be tapped with threads to ANSI/AWWA C800.

.10 Tee connections: for services 100mm diameter and above. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.6 YARD HYDRANTS

- .1 Yard Hydrants: Terminal City self-draining stand pipe, factory assembled unit:
 - .1 Hydrants to open threads to local standard, Provide metal caps and chains.
 - .2 Yard Hydrant to be manufactured with bronze operating and draining components.
 - .3 The stuffing box and draining mechanism to have "O" ring rubber gaskets for sealing purposes.
 - .4 Polyurethane anti-score seating material is used for the valve disc facing.
 - .5 Provide key operated gate valve located 1m from hydrant.
 - .6 Depth of bury 1.2 m.

.2 Hydrant paint: exterior enamel to CAN/CGSB-1.88,MPI #96.

2.6 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Crushed or screened stone, gravel or sand.
- .2 Table

Sieve Designation	Percent Passing	
	Type 1*	Type 2*
25.0mm	100	100

19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	-
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm	-	3-20
0.075mm	0-5	0-8
*Type 1: Standard Gradation *Type 2: To be used only in dry trench conditions and with prior approval of Department Representative.		

- 2.7 BACKFILL MATERIAL .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 2.8 PIPE DISINFECTION .1 Sodium hypochlorite to ANSI/AWWA B300 to disinfect water mains.
- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.
- PART 3 - EXECUTION
- 3.1 PREPARATION .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
- .1 Inspect materials for defects to approval of the Department Representative.
- .2 Remove defective materials from site as directed by Department Representative.
- 3.2 TRENCHING .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 1.2 m from finished grade or as indicated.
- .3 Trench alignment and depth require Department Representative approval prior to placing bedding material and pipe.
- 3.3 CONCRETE BEDDING AND ENCASEMENT .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete to details as indicated.
- .3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% modified proctor density to ASTM D1557.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.5 PIPE INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings.
- .4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed one half of permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent

- entry of foreign materials.
- .9 Position and join pipes with equipment and methods approved by Department Representative.
 - .10 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
 - .11 Align pipes before jointing.
 - .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
 - .14 Complete each joint before laying next length of pipe.
 - .15 Minimize deflection after joint has been made.
 - .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
 - .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Department Representative.
 - .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
 - .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
 - .20 Install tracer wire along entire length of watermain with Test boxes located at maximum 1000m separation.
 - .21 Do not lay pipe on frozen bedding.
 - .22 Do hydrostatic and leakage test and have results approved by the Department Representative before surrounding and covering joints and fittings with granular material.
 - .23 Backfill remainder of trench.

- 3.6 VALVE INSTALLATION .1 Install valves to manufacturer's recommendations at locations as indicated.
- 3.7 VALVE CHAMBERS .1 Use precast units as approved by the Department Representative.
- .2 Construct units as indicated, plumb and centered over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .4 Plug lifting holes with precast concrete plugs set in cement mortar.
- .5 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .6 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.
- 3.8 SERVICE CONNECTIONS .1 Terminate building water service 1 m outside building wall or as indicated opposite point of connection to main. Locate point of connection in advance and advise Department Representative.
- .2 Cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed.
- .4 Tappings on ductile iron mains 2000mm or greater in diameter may be threaded with service clamps provided specified pipe wall thickness is sufficient to confirm to ANSI/ASME B1.20.1 for at least 3 threads as shown in Appendix A to AWWA C151.
- .5 Tappings in ductile iron mains smaller in diameter than 200mm; or ductile iron mains with wall thickness which will not allow at least 3 full threads; or tap size beyond those shown in the following table are to be made using double strap saddles

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	19	25
150	25	32

200	25	50
250	25	50
300	32	75

- .5 Tappings in PVC mains to AWWA C900 pipe to be with services saddles. Nuts on service saddle stapes to be tightened to torque range specified by manufacturer and in no case in excess of that torque. Use core-out type bit, provide coupons to Departmental Representative.
- .6 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .7 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .8 Employ only competent persons equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .9 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .10 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 500mm apart along pipe.
- .11 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.
- .12 Leave corporation stop valves fully open.
- .13 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .14 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .15 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .16 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.9 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install hydrant assemblies in accordance with AWWA M17 and in accordance with standard details on the drawings.
- .3 Set hydrants plumb, with hose outlets parallel with edge of pavement with outlet facing roadway. Flange set at elevation of 50 to 150mm above finish grade
- .4 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .5 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .4 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.10 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Department Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Department Representative

3.11 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Department Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Department Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.

- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the Department Representative.
- .6 Upon completion of pipe laying and after Department Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed as directed by Department Representative.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.
- .13 Apply hydrostatic test pressure of 1035 kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hours.
- .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .16 Repeat hydrostatic test until defects have been corrected.
- .17 Define leakage as amount of water supplied in order to maintain test pressure for 2 hours.
- .18 Locate and repair defects if leakage is greater than amount specified.
- .19 Repeat test until leakage is within specified allowance for full length of water main.

3.12 PIPE SURROUND

- .1 Upon completion of pipe laying and after Department

Representative has inspected Work in place, surround and cover pipes as indicated.

- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% maximum density to ASTM D 698.

3.13 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under roadways and pathways, compact backfill to at least 95% maximum density to ASTM D 698.

3.14 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants red.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.15 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Department Representative.
 - .1 Notify Department Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear. The contractor shall supply all water for flushing and testing.
- .3 Flushing flows as follows:

Pipe Diameter	Flow (L/s) Minimum
150mm and below	38
200mm	75
250mm	115
300mm	150

- .4 Provide connections and pumps for flushing as required.
 - .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
 - .6 When flushing has been completed to Department Representative approval, introduce strong solution of chlorine as approved by Department Representative into water main and ensure that it is distributed throughout entire system.
 - .8 Rate of chlorine application to be proportional to rate of water entering pipe.
 - .9 Chlorine application to be close to point of filling water main and to occur at same time.
 - .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
 - .11 Flush line to remove chlorine solution after 24 hours.
 - .12 Measure chlorine residuals at extreme end of pipe-line being tested.
 - .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of two days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Specialist contractor to submit certified copy of test results.
 - .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
 - .15 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- 3.16 SURFACE RESTORATION
- .1 After installing and backfilling over water mains, restore surface to original condition as approved by the Department Representative.

END OF
SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Materials and installation for gravity sewers.

1.2 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 31 23 10-Excavating, Trenching and Backfilling.
- .3 Section 33 05 13-Manholes and Catch Basin Structures.

1.3 References

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 14M-99, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C 76M-02, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .3 ASTM C 117-95, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C 136-01, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C 443M-02, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .6 ASTM C 700-02, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
 - .7 ASTM C 828-01, Standard Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines.
 - .8 ASTM D 698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .9 ASTM D 2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .10 ASTM D 3034-00, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .11 ASTM D 3350-02, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .4 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-98, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
 - .1 CAN/CSA-A5-F98, Portland Cement.
 - .2 CAN/CSA-A257 Series-M92(R1998, Standards for Concrete Pipe.

- .3 CSA-B70-02, Cast Iron Soil Pipe, Fittings, and Means of Joining.
- .4 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
 - .3 CSA B182.6-02, Profile Polyethylene Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.4 Definitions

- .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

1.5 Submittals

- .1 Certification to be marked on pipe.

1.6 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufactures recommendations.

1.7 Waste Management and Disposal

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .3 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .5 Dispose of unused asbestos cement pipe in accordance with regulations governing the disposal of hazardous materials.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Scheduling

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 - PRODUCTS

2.1 Concrete Pipe

- .1 Non-reinforced circular concrete pipe and fittings: to ASTM C 14M as indicated, designed for flexible rubber gasket joints to ASTM C 443M.
- .2 Reinforced circular concrete pipe and fittings: to ASTM C 76M as indicated, designed for flexible rubber gasket joints to ASTM C 443M.
- .3 Lifting holes:
 - .1 Pipe 900mm and less diameter: no lift holes.
 - .2 Pipe greater than 900mm diameter: lift holes not to exceed two in piece of pipe.
 - .3 Provide pre-fabricated plugs to effectively seal lift holes water tight after installation of pipe.

2.2 Plastic Pipe

- .1 Polyvinyl chloride pipe up to 675mm in diameter, DR35. Pipe to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specification for pipe size ranges as follows:
 - .1 100mm dia. – 375mm dia. to ASTM D3034
 - .2 450mm dia. – 1200mm dia. to ASTM F679.
- .2 Pipes to be certified by Canadian Standards Association to standards for pipe size ranges below.
 - .1 100mm dia. – 1200mm dia. to CSA B182.2
- .3 Joint: Pipe to include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; joints to conform to ASTM D3212, gaskets to ASTM F477.
- .4 Normal pipe length joint to joint to be 4m.
- .5 Maximum installed deflection not to exceed 7.5% of the base inside diameter.

2.3 Service Connections

- .1 Sanitary sewer service connections to be 100mm minimum diameter; maximum diameter as specified on Contract Drawings.
- .2 Sanitary sewer service connections 100mm and 150mm diameter to be PVC type DR28 sewer pipe.
- .3 100mm and 150mm DR28 PVC sanitary service connection pipe to have a minimum pipe stiffness of 625kPa. Pipe to be manufactured to ASTM D3034 and certified by Canadian Standards Association to CSA B182.2
- .4 Sanitary sewer service connections greater than 150mm diameter to be of size and material specified on Contract Drawings and to conform to applicable specifications for mainline pipe.
- .5 Manufactured connections to non-reinforced or reinforced concrete mainline pipe to be made using sanded PVC pipe male end stub with integral bell by either:
 - .1 Stub grouted into neatly chipped hole in pipe wall by concrete pipe

- manufacturer. Grout to be Portland cement based grout.
- .2 Stub epoxy resin cemented into neatly cored hole in pipe wall by concrete pipe manufacturer.
 - .6 Stub and bell orientation to be 45° to centerline of mainline pipe (wyes) for concrete pipe less than 1050mm diameter. Orientation may be 90° to centerline of mainline pipe (tees) for concrete pipe 1050mm diameter or larger. No section of service stubs to protrude past inside of concrete pipe wall.
 - .7 Manufactured wye connections to PVC mainline pipe to be made with extrusion moulded PVC or fabricated PVC fittings manufactured to ASTM D3034 and CSA B182.2
 - .8 Field installed tees and wyes:
 - .1 In-situ installation of tees and wyes into concrete or PVC mainline pipe shall be made with approved PVC swaddle installed to the manufacturers specifications into a neatly cored hole in the pipe wall.
 - .2 Connections to ribbed PVC pipe to be made with a preformed tee and wye fitting when connection is up to two sizes smaller than mainline pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for ribbed PVC pipe is permitted. When an insertable is used, hole cut into mainline pipe to cut as few ribs as possible.
 - .9 PVC service connection pipe and fitting joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477. Normal pipe laying length joint to joint to be 4.0m.
 - .10 Pipe and fitting joints for service connection pipe materials other than PVC type PSM sewer pipe to be as specified for applicable mainline pipe.

2.4 Cement Mortar

- .1 Portland cement: to CAN/CSA-A5.
- .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.

2.5 Pipe Bedding And Surround Material

- .1 Granular material in accordance with Section 31 05 16 - Aggregate Materials
- .2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Cast-in-Place Concrete.

2.6 Backfill Material

- .1 As indicated.
- .2 In accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 Preparation

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- .2 Obtain Departmental Representative approval of pipes and fittings prior to installation.

3.2 Trenching

- .1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 Concrete Bedding And Encasement

- .1 Do concrete Work in accordance with Cast-in-Place Concrete. Place concrete to details as indicated.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.
 - .1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 h after placing.

3.4 Granular Bedding

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layer[s] not exceeding 150mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% Modified Proctor Density in compliance with ASTM D1557.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 Installation

- .1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

- .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Lay corrugated steel pipe:
 - .1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.
 - .2 With longitudinal centre line of paved invert coinciding with flow line.
- .6 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CSA B182.11.
- .10 Joints:
 - .1 Install gaskets as recommended by manufacturer.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .12 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .13 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .14 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .15 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.

- .1 Joint to be structurally sound and watertight.
- .16 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 Pipe Surround

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150mm compacted thickness as indicated.
 - .1 Do not dump material within 1 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 Backfill

- .1 Place backfill in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
- .2 Compaction: place backfill and compact to following Modified Proctor densities in compliance with ASTM D1557. (all following references to density imply compliance with ASTM D1557)
 - .1 Boulevards and easements to minimum 90%
 - .2 Roads, driveways, shoulders, re-shaped ditches and sidewalks to minimum 95%.
 - .3 Use caution in pipe zone to ensure no damage to pipe.

3.8 Service Connections

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
- .2 Maintain grade for services as indicated on Contract Drawings unless directed otherwise by Departmental Representative.
- .3 Service connections to main sewer: Wye fittings or Departmental Representative approved saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connection pipe: not to extend into interior of main sewer.
- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of four pipe diameters.
 - .1 Use long sweep bends where applicable.

- .6 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.
- .7 Install inspection chamber at specified location set plumb and to specified elevation. If inspection chamber located in driveway, lane or paved surface install cover or lid as shown on Contract Drawings.
- .8 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 40 x 90 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.9 Field Testing

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Upon completion of cleaning and flushing of each section carry out leakage testing. Tests may include one or more of the following:
 - .1 Low Pressure Air Test
 - .2 Exfiltration test – using water
 - .3 Infiltration test

Testing to be completed as soon as practicable after jointing and bedding are complete, and service connections have been installed. All tests shall be performed in the presence of a Department Representative.

- .5 Carry out tests on each section of sewer between successive manholes including service connections.
- .6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .7 Low Pressure Air Test:
 - .1 Low pressure air test to include testing of sewer main and service connections in each section. Test manholes by either exfiltration test utilizing water or by low pressure air as specified.
 - .2 Wet inside perimeter of concrete pipes in test section then increase pressure in test section prior to conducting air tests. Then increase pressure in test section to 24 kPa above average groundwater pressure and observe rate of pressure drop.
 - .3 Maintain 25 kPa above average ground water pressure for at least 5.0 minutes before commencing internal air pressure test. Regulate air pressure to prevent pressure inside test section from exceeding 35 kPa above average ground water pressure.
 - .4 Commence test period when pressure decreases to 24.0 kPa above average groundwater pressure and end when pressure decreases to 20.5 kPa above average groundwater pressure. Do not add air to test section during test

period. If test period is less than:

- 2 minutes and 32 seconds for 100mm pipe
- 3 minutes and 50 seconds for 150mm pipe
- 5 minutes and 6 seconds for 200mm pipe
- 6 minutes and 22 seconds for 250mm pipe
- 7 minutes and 39 seconds for 300mm pipe

Sewer shall be deemed to have failed test. Retest upon completion of repair to any leaks.

.5 Department Representative reserves right to withdraw permission to use this test procedure at any time and to require Contractor to carry out exfiltration test utilizing water.

.8 Exfiltration test:

.1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.

.2 Immediately prior to test period add water to pipeline until there is head of 1.2 m over interior crown of pipe measured at highest point of test section or water in manhole is 1.2 m above static ground water level, whichever is greater.

.3 Duration of exfiltration test: 3 hours.

.4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.

.9 Infiltration test:

.1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.

.2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.

.3 Install watertight plug at upstream end of pipeline test section.

.4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.

.5 Prevent damage to pipe and bedding material due to flotation and erosion.

.6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.

.7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.

.10 Exfiltration allowable leakage from pipe will be calculated using following formula:

$$\text{Allowable Leakage (L)} = \frac{H \times D \times L}{K}$$

Where: H = duration of test in hours,
D = pipe diameter in millimeters
L = length of test section in metres
K = 840

.11 Where service connections exist along test section allowable leakage from service connections to be calculated by use of above formula and added to that of main sewer leakage to arrive at total allowable leakage. No additional leakage allowance to be made for manholes in test section.

- .12 Infiltration allowable leakage to be same as that calculated for exfiltration less 10% if external head is 600mm or less. Above infiltration limits to constitute maximum total allowable infiltration for section.
- .13 Repair and retest sewer line as required, until test results are within limits specified.
- .14 Repair visible leaks regardless of test results.
- .15 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.
 - .3 Payment for inspection services in accordance with payment procedures in PART 1.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Materials and installation for storm sewer.

1.2 Related Sections

- .1 Section 31 05 16-Aggregate Materials.
- .2 Section 31 23 10-Excavating, Trenching and Backfilling.
- .3 Section 33 05 13-Manholes and Catch Basin Structures.

1.3 Measurement Procedures

- .1 All work included in this section shall be included in the lump sum bid for all materials, equipment and labour for the scope of work shown on the plans and specifications.

1.4 References

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 14M, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C 76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .3 ASTM C 117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C 443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .6 ASTM C 506M, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
 - .7 ASTM C 507M, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).
 - .8 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .9 ASTM D 1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - .10 ASTM D 2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .11 ASTM D 3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .12 ASTM F 405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
 - .13 ASTM F 667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.
 - .14 ASTM F 794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- .2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 CAN/CGSB-34.9, Asbestos-Cement Sewer Pipe.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
 - .1 CAN/CSA-A5, Portland Cement.
 - .2 CAN/CSA-A257 Series-[M92(R1998)], Standards for Concrete Pipe.
 - .3 CSA B1800-[02], Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).
 - .2 CSA B182.4, Profile PVC Sewer Pipe and Fittings.
 - .3 CSA B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
 - .4 CSA-G401, Corrugated Steel Pipe Products.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.5 Definitions

- .1 A pipe section is defined as length of pipe between successive catchbasins and/or manholes.

1.6 Submittals

- .1 Certification to be marked on pipe.

1.7 Waste Management and Disposal

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .3 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .5 Dispose of unused asbestos cement pipe in accordance with regulations governing the disposal of hazardous materials.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.8 Scheduling

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 PRODUCTS

2.1 Concrete Pipe

- .1 Non-reinforced circular concrete pipe and fittings: to ASTM C 14M as indicated, designed for flexible rubber gasket joints to ASTM C 443M.
- .2 Reinforced circular concrete pipe and fittings: to ASTM C 76M as indicated, designed for flexible rubber gasket joints to ASTM C 443M.
- .3 Reinforced concrete arch pipe: to ASTM C 506M.
- .4 Reinforced concrete elliptical pipe: to ASTM C 507M.
- .5 Lifting holes:
 - .1 Pipe 900mm and less diameter: no lift holes.
 - .2 Pipe greater than 900mm diameter: lift holes not to exceed two in piece of pipe.
 - .3 Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

2.2 Plastic Pipe

- .1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D 3034 CSA-B182.2.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Separate gasket and integral bell system.
 - .3 Nominal lengths: 4 m.
- .2 Large diameter, ribbed PVC sewer pipe and fittings: to CSA B182.4 ASTM F 794.

2.3 Pipe Bedding and Surround Material

- .1 Granular material in accordance with Section 31 05 16 - Aggregate Materials
- .2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Cast-in-Place Concrete.

2.4 Backfill Material

- .1 As indicated.

2.5 Joint Mortar

- .1 Portland cement: to CAN/CSA-A5.
- .2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

PART 3 EXECUTION

3.1 Preparation

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 Trenching

- .1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

- .2 Do not allow contents of sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 Concrete Bedding and Encasement

- .1 Do concrete work in accordance with Cast-in-Place Concrete. Place concrete to details as indicated.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.
 - .1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 h after placing.

3.4 Granular Bedding

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layer[s] not exceeding 150mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% Modified Proctor Density in compliance with ASTM D1557.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.5 Installation

- .1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .7 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Joints:
 - .1 Install gaskets as recommended by manufacturer.

- .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .3 Align pipes before joining.
- .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
- .6 Complete each joint before laying next length of pipe.
- .7 Minimize joint deflection after joint has been made to avoid joint damage.
- .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .11 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes and catch basins.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
 - .1 Joint to be structurally sound and watertight
- .15 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 Pipe Surround

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% Modified Proctor Density.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 Backfill

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150mm compacted thickness up to grades as indicated.

- .3 Under paving and walks, compact backfill to at least 95% Modified Proctor Density.

3.9 Field Testing

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.

END OF SECTION

1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 11 00 – Summary of Work.
- .3 Section 26 05 00 – Common Work Results – Electrical
- .4 Section 26 05 14 – Power Cables and Overhead Conductors

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 211. (latest edition), Rigid Types EBI and DB2/ES2 PVC Conduit.
 - .2 CSA C22.2 No. 211.3 (latest edition), Reinforced Thermosetting Resin Conduit (RTRC) and Fittings (Bi-national standard, with UL 1684).

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 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and Handle materials in accordance with Section 26 05 00 – Common Work Results Electrical

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Dispose of unused solvent cement at an official hazardous material collections sites as approved by Consultant. 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.

2. PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: to CSA C22.2 No. 211.1, type rigid PVC for direct burial with minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm. Type DB2 (thinwall) PVC conduits unacceptable.
- .2 Duct sizes per Drawings.
- .3 Rigid PVC split ducts.
- .4 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.
- .5 Rigid PVC 90° and 45° bends.
- .6 Rigid PVC 5° angle couplings.
- .7 Use epoxy coated galvanized steel conduit for sections extending above finished grade.
- .8 Expansion joints at transition to EMT or rigid metal conduit at building entry.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.

2.3 PLASTIC POLYETHYLENE PIPE

- .1 Rigid plastic polyethylene pipe with approved couplings and fittings required to make complete installation.

2.4 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.5 MARKERS

- .1 Markers on grade not required.
- .2 150 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape. Install at depth as per drawings.

3. EXECUTION

3.1 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.
- .6 Pull through each duct wooden 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. Pull rope shall be left in spare ducts for future use.
- .8 Install markers as required.
- .9 Do not conceal conduits until written approval from Consultant is provided.
- .10 Do not conceal mechanical protection until written approval from Consultant is provided.

END OF SECTION

Appendix 'A' – Materials and Colours Schedule

Examples of acceptable products.

Other products having the same demonstratable characteristics will not be excluded.

Section 06 20 00 – Finish Carpentry and Millwork

Paint finishes per 09 90 00

2.1. Materials:

7. Plastic Laminate:

- .1 PL-1 Wilsonart - Premium Laminate, Veranda Teak (8209K-28, Gloss line Finish). AEON Scratch Resistance
- .2 PL-2 Wilsonart - Standard Laminate, Desert Zephyr (4841-60, Matt Finish). AEON Scratch Resistance
- .3 PL-3 Plastic laminate aroborite colour – Inukshuk Carbon P-346 RM

2.2 Cabinet Hardware:

- .1 Hinges: High quality all metal concealed European (Blum) style for overlay door application.
- .2 Door and Drawer Locks: 22mm (7/8") Pin Tumbler Drawer/Cabinet deadbolt Lock, 26D finish, all keyed alike.
- .3 HD-1 Door and Drawer Pulls: metal D-pull, Stainless steel
 - .1 RICHELIEU - Contemporary Stainless-Steel Pull - 527 (Product #: BP527224195) – 237mm length - Diameter 13mm- Brushed Nickel 195.
- .4 Drawer Slides: Full extension heavy-duty type, steel ball bearings, closed position hold-in, positive out-stop.

All shelf pins shall be metal. All door and drawer pulls, metal D pull, stainless steel.

2.3 Locker Hardware

.1 Coat Hooks

- .1 HD-5a heavy duty triple coat hook at locker interior.
RICHELIEU - 4 1/2" heavy duty triple coat hook (236fbv – black) - size: 98m x 71mm x 57mm
- .2 1 coat rod.
Acceptable Product example:
RICHELIEU - Round Closet Rods- Chrome Finish (Product # 43108140)

.2 Door and Drawer pulls

- .1 HD-1 Door and Drawer Pulls: metal D-pull, Stainless steel
RICHELIEU - Contemporary Stainless-Steel Pull - 527 (Product #: BP527224195) – 237mm length - Diameter 13mm- Brushed Nickel 195.

2.4 Desk Hardware

.1 Desk Support Leg, Aluminum

- RICHELIEU - Adjustable Metal Table Leg – 6207 (Product #: 620710175) – Brushed Nickel Finish

Section 07 42 00 – Metal Wall Cladding & Soffit

- .1 Long Board siding and Soffit:
 - .1 Finish coating: powder coated finish
 - .1 Colour: Classic Bronze 101337
 - .2 Gloss: 30 ± 5.
 - .2 Thickness: 1.52 mm base metal thickness.
 - .3 Profile: 6 inch (152.4mm) V-Groove 24 ft (7315.2mm) plank, extruded aluminum 6063 T5

Section 08 44 13 – Aluminum Curtainwall

- 2.5 Aluminum Curtainwall (Standard Capped)
“1600 Wall System™¹ by Kawneer – Colour Champagne No.18
- 2.6 Storefront Doors
560 Insulclad™ Thermal Entrances – Colour Champagne No.18
- 2.7 Insulated Spandrel Panel
Kawneer Metal Sheet - Colour Champagne No.18
Products having the same characteristics produced by Columbia Aluminum Products, Alumicor or U.S. Aluminum will not be excluded.

Section 08 11 00 – Steel Doors and Frames

Paint finishes per 09 90 00

Section 09 30 13 – Ceramic Tile

- 2.2 Wall Tile
 - Ames Tile and Stone; Soho Collection
 - .1 T1 Washroom, SOHWG36; White
 - .2 T2 Kitchen Backsplash, SOHGG36; Grey

Section 09 51 13 – Acoustic Ceiling Panels

- 2.1 Type ‘ACT-1’ Acoustic Ceiling Tile
No. 1944, “Ultima® high-NRC” tegular tile by Armstrong Ceilings
- 2.2 Type ‘ACT-2’ Acoustic Ceiling Tile
No. 1938, “Ultima®” square lay-in fine textured tile by Armstrong Ceilings.

Section 09 65 00 – Resilient Flooring

- 2.1. Resilient Flooring
 - .1 (RF-1) Armstrong Corlon / Pattern: Connection / Colour: Otter Grey 88717.
 - .2 (RB-1) Rubber Base, Johnsonite, 4” high cove / Colour: Grey#48 by Tarketta

Section 09 68 00 – Carpeting

2.1 Carpet

- .1 (CP-1) Shaw Carpet Tile / Style: Sync Up Jo126 / Colour: Datebook 26105.

Section 09 90 00 – Painting and Coating

Painting Schedule

3.6 .2 Exterior Surfaces: (Refer to Chapter 2, MPI Manual)

- .1 Hollow metal doors and frames (galvanized)
EXT 5.3D WB light industrial coating, (gloss level 3) (modify by cleaning/etching first with MPI product #25)
Colours: Custom to match cladding colour
- .2 Condensing unit Unitrust: EXT 5.3D
- .3 Handrails and Guardrails
Galvanized, clear coat

.2 Interior Surfaces: (Refer to Chapter 3, MPI Architectural Painting Specifications Manual)

- .3 Plywood Finishes (PLY-1): (Premium Grade) Fire Retardant, Pigmented INT 6.2F
- .4 Window Sill/Head/Jamb plywood Trim (PLY-2): Lacquer, Clear 6.3H
- .5 Doors and Frames (PT-1): High Performance Architectural Latex INT 5.3M, G2;
Colour: To be selected by Consultant.
- .6 Drywall (PT-2): High Performance Architectural Latex. INT 9.2B, G2
Colour: White BM-OC-68 Distant Grey
- .5 Exposed Structural Detail: Colour: To be selected by Consultant.

Section 10 28 00 – Washroom Accessories

- .1 Toilet paper dispensers (WA-3)
Bobrick - Surface-Mounted Multi-Roll Toilet Tissue Dispenser - B-4288
- .2 Feminine napkin disposals (WA-4)
Bobrick - Recessed Sanitary Napkin Disposal- B-353
- .3 Grab bars (WA-5 & WA-6)
Acceptable Product examples:
(WA-5) - Bobrick - Stainless Steel 90-Degree Grab Bar - B-5898.99
(WA-6) - Bobrick - Stainless Steel Grab Bars With Snap Flange (610mm) - B-5806.99
- .4 Soap Dispenser (WA-2)

- Bobrick - Automatic Wall-Mounted Soap Dispenser - No. B-2012.
- .5 Electric hand dryer (WA-1)
Bradley - Adjustable Motor, Sensored, "Hands In" High Speed Hand Dryer- 2921-S.
Dyson – Airblade dB - AB14 Grey
- .6 Robe hook (HD-5)
Bobrick - Surface Mounted Hat And Coat Hook- B-6827 - Satin Finish Stainless Steel

END OF SECTION

RYZUK GEOTECHNICAL
Engineering & Materials Testing

28 Crease Avenue, Victoria, BC, V8Z 1S3 Tel: 250-475-3131 Fax: 250-475-3611 www.ryzuk.com

September 9, 2019
File No: 4070-8

CWMM Consulting Engineers Ltd.
2nd Floor, 1412 W 7th Avenue
Vancouver, BC
V6H 1C1

Attn: Patrick Lam, M.Sc, P.Eng, Principal & Chief Structural Engineer

Dear Mr. Lam,

Re: Institute of Ocean Sciences Guard House
9860 West Saanich Road - North Saanich, BC

As requested, we have carried out a desktop study of the geotechnical conditions at the above referenced site. The following letter provides basic recommendations regarding the proposed development. Our work in this regard has been carried out in accordance with and is subject to our attached Terms of Engagement.

PROPOSED DEVELOPMENT

The site is located west of the Victoria International Airport approximately 65 m north of West Saanich Road within the DFO properties located at 9860 West Saanich Rd in North Saanich. The proposed development is located within a grass landscaped area northeast of a recently modified paved parking lot. We understand that the proposed guard house is to be an at grade wood-framed single storey structure with conventional strip and pad foundations.

ANTICIPATED SUBSURFACE CONDITIONS

Our geotechnical review consisted of reviewing previous projects within the immediate vicinity and available geological mapping. Based on the available information, the following describes the anticipated subsurface conditions at the site. It should, however, be noted that since no subsurface investigation was carried out, the actual soils conditions may vary from those described.

From our recent involvement with the parking lot modifications to the southeast, we expect that soil conditions will consist of relatively thin fills/surficial organics (< 1m) over native soils consisting of a thin layer of silty sand transitioning to very stiff brown silty clay underlain by grey firm silty clay and glacial till at depth. While not expected in the proposed guardhouse location, it should be noted that these fills locally increased in thickness to up to 1.6 m.

GEOTECHNICAL RECOMMENDATIONS

Excavation Considerations

We expect that the excavation can be readily accomplished using hydraulic excavator equipment. All structures, fills, buried tanks, etc., associated with past/current site use will need to be removed down to native subgrade soils.

As the proposed building is designed with to be at grade, we anticipate excavations for the proposed development will range in depths of up to 1 metre. These depths will vary depending on the proposed slab elevation in relation to the current sloping site grade.

We expect temporary excavation cutslopes will be stable at the following configuration (provided that adequate space is available), though such will need to be assessed at early stages of the excavation by a geotechnical professional.

- 1 H to 1 V (Horizontal : Vertical) for fill materials, and
- 0.5 H to 1 V for the compact silty sand or very stiff brown silty clay.

According to WorkSafeBC guidelines, excavations deeper than 1.2 m must be inspected and approved by a qualified geotechnical professional.

Seismic Considerations

Greater Victoria is situated in a region of very high seismicity. Considerable earthquake risk exists, stemming from our proximity to the Cascadia subduction zone and numerous more local faults in southwestern BC and northwestern Washington State.

Based on soil conditions anticipated at this site, it is reasonable to expect the shear wave velocity in the upper 30 m (V_s^{30}) to be between 360 and 760 m/s. This corresponds to a Site Classification for Seismic Site Response of 'C', in accordance with the 2018 BC Building Code. Table 1 provides the associated seismic acceleration spectra for the required design seismic event. The raw data obtained from Seismic Hazard Calculator is included as an attachment to this report.

Table 1: NBC 2015 Spectral Accelerations for 2% in 50-year Probability Event

Period (sec)	PGA	0.2	0.5	1.0	2.0	5.0	10.0
Response (g) Site Class 'C'	0.59	1.23	1.11	0.64	0.38	0.12	0.04

Settlement Considerations

Provided adverse soils (i.e. topsoils and fill) are removed from all foundation areas, we expect that settlement at this site will be minor, if any, and of minimal significance to the structural or geotechnical design.

Foundations

We expect typical pad and strip footings are the preferred foundation choice. At a minimum, all existing topsoil and fill will need to be removed from the proposed building locations. If, after removal of undesirable soils, it is desired to raise the grade back to design grade, backfill should consist of approved engineered fills. For frost protection, the base of all footings should extend to a depth of at least 450 mm below adjacent finished grades. Minimum footing widths of 0.4 and 0.6 meters are recommended for strip and pad footings respectively.

For design purposes, and assuming strip and pad footings bearing on native clays, or suitable engineered fills placed upon such, Table 2 provides anticipated bearing resistances. Should larger foundations be required, adjusted bearing resistances can be provided.

Table 2: Limit States Design Bearing Capacity of Soils

Stratigraphic Layer	Limit States Design (LSD)	
	SLS	ULS
Native stiff brown silty clay	150 kPa	225 kPa

Limit state design values use a geotechnical resistance factor of 0.5 as per the current Canadian Foundation Engineering Manual. All foundation subgrade areas will need to be inspected by the project geotechnical personnel to confirm the above noted bearing resistance values are as anticipated prior to placement of concrete foundations or ground seal.

Engineered fills, if required, shall consist approved well graded granular material and shall be placed in maximum 300 mm lifts and compacted to 95% Standard Proctor Maximum Dry Density (SPMDD). Engineered fill must extend beyond footing lines by an amount at least equal to depth of fill placed.

Foundation Walls

Foundation walls should be backfilled with clean, well graded granular material, compacted in maximum 300 mm lifts to at least 95% of Standard Proctor Maximum Dry Density (SPMDD). Where the grade elevation differs significantly between the two sides of a perimeter wall and the wall is free to rotate in order to develop the active earth pressure state (rotation of 0.1% of the wall height, non rigid wall), the wall should be designed to resist a lateral earth pressure (due to granular backfill) similar in magnitude and distribution to that of a fluid having a unit weight of 6.3 kN/m^3 .

Lateral earth pressures due to floor loadings and/or foundation loads from adjacent portions of the building can be calculated assuming a lateral coefficient of 0.35. Where the wall cannot rotate (rigid wall), it should be designed to resist an at rest lateral earth pressure loading, similar in magnitude and distribution to that of a fluid having a unit weight of 8.6 kN/m^3 . In this case, lateral earth pressure due to floor loadings and/or foundation loads from adjacent buildings can be calculated assuming a lateral coefficient of 0.45. Equipment larger than a bobcat should not be allowed within 1.5 m of the foundation walls during backfilling.

Lateral earth pressures resulting from seismic activity can be calculated according to the following equations:

$$\text{Non Rigid Wall : } P_E = 0.375 k_h \gamma H^2$$

$$\text{Rigid Wall : } P_E = 0.5 k_h \gamma H^2$$

where:

- P_E is the resultant force per unit length of wall;
- the coefficients of 0.375 and 0.5 are dimensionless;
- k_h is the design peak horizontal ground acceleration coefficient;
- γ is the moist unit weight of the backfill material, which is approximately 20.4 kN/m^3 for most granular backfill;
- H is the height of the wall.

In the case of the non rigid wall, the backfill pressure distribution resulting from the earthquake loading can be assumed to be triangular, increasing from zero at the base of the wall to a maximum of $0.75 k_h \gamma H$ at the top of the wall, with the resultant force acting at $0.67H$ above the base of the wall. In the case of the rigid wall, the backfill pressure distribution resulting from the earthquake loading can be assumed to be parabolic, with the resultant force acting at $0.5H$ above the base of the wall.

For design purposes, the pressure distribution resulting from earthquake loading on the backfill should be added to either the active or at rest pressure distribution depending on whether or not the noted wall rotation can occur.

Slab on Grade

Use of a grade supported floor slab is considered feasible for the proposed development. In areas of very stiff brown silty clay, a minimum of 150 mm layer of well compacted free draining select granular fill placed on approved subgrade is recommended immediately beneath the slab. The slab construction should incorporate a standard sub slab polyethylene vapour barrier to minimize capillary rise of moisture into the slab. All sub slab fill should be compacted to at least 95% SPDMM value.

Foundation Drainage

Conventional perimeter foundation drainage consisting of perforated drain pipe surrounded by free draining granular material containing low fines, tied into the recommended free draining backfill material is recommended. To prevent the migration of fine-grained soil particles into the drainage system, a layer of medium weight, non-woven geotextile should be placed between the clean drain rock around the perforated pipe and the granular backfill material. The geotextile should encompass the entire drain rock/drain pipe system.

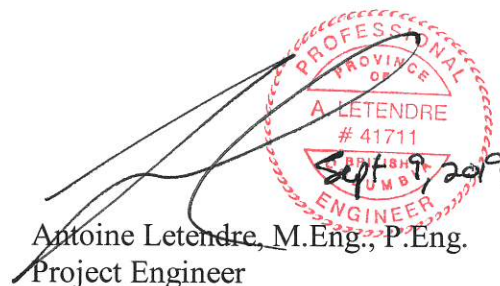
In general, pipe inverts should be kept at least 300 mm below interior grades. Any structures that extend below the invert of adjacent perimeter/interior drainage will be subject to moisture ingress unless they are waterproofed/tanked or are provided with localized drainage. Such structures provided without drainage must be designed to accommodate hydrostatic pressure.

We hope the preceding is suitable for your purposes at present. Please don't hesitate to contact our office if we can be of further assistance.

Yours truly,
Ryzuk Geotechnical



Simon Jones, EIT
Junior Engineer



Antoine Letendre, M.Eng., P.Eng.
Project Engineer

Attachment – Terms of Engagement
2015 NBC Seismic Hazard Calculator



TERMS OF ENGAGEMENT

GENERAL

Ryzuk Geotechnical (the Consultant) shall render the Services, as specified in the agreed Scope of Services, to the Client for this Project in accordance with the following terms of engagement. The Services, and any other associated documents, records or data, shall be carried out and/or prepared in accordance with generally accepted engineering practices in the location where the Services were performed. No other warranty, expressed or implied is made. The Consultant may, at its discretion and at any stage, engage sub-consultants to perform all or any part of the Services.

Ryzuk Geotechnical is a wholly owned subsidiary of C. N. Ryzuk & Associates Ltd.

COMPENSATION

All charges will be payable in Canadian Dollars. Invoices will be due and payable by the Client on receipt of the invoice without hold back. Interest on overdue accounts is 24% per annum.

REPRESENTATIVES

Each party shall designate a representative who is authorized to act on behalf of that party and receive notices under this Agreement.

TERMINATION

Either party may terminate this engagement without cause upon thirty (30) days' notice in writing. On termination by either party under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed, including all expenses and other charges incurred by the Consultant for this Project.

If either party breaches this engagement, the non-defaulting party may terminate this engagement after giving seven (7) days' notice to remedy the breach. On termination by the Consultant under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed to the date of termination, including all fees and charges for this Project.

ENVIRONMENTAL

The Consultant's field investigation, laboratory testing and engineering recommendations will not address or evaluate pollution of soil or pollution of groundwater. The Consultant will cooperate with the Client's environmental consultant during the field work phase of the investigation.

PROFESSIONAL RESPONSIBILITY

In performing the Services, the Consultant will provide and exercise the standard of care, skill and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the Services contemplated in this engagement at the time when and the location in which the Services were performed.

INSURANCE

Ryzuk Geotechnical is covered by Professional Indemnity Insurance as follows:

1. \$ 3,000,000 each and every claim
2. \$ 5,000,000 aggregate
3. \$ 5,000,000 commercial/general liability coverage

LIMITATION OF LIABILITY

The Consultant shall not be responsible for:

1. the failure of a contractor, retained by the Client, to perform the work required for the Project in accordance with the applicable contract documents;
2. the design of or defects in equipment supplied or provided by the Client for incorporation into the Project;
3. any cross-contamination resulting from subsurface investigations;
4. any Project decisions made by the Client if the decisions were made without the advice of the Consultant or contrary to or inconsistent with the Consultant's advice;
5. any consequential loss, injury or damages suffered by the Client, including but not limited to loss of use, earnings and business interruption;
6. the unauthorized distribution of any confidential document or report prepared by or on behalf of the consultant for the exclusive use of the Client
7. Subsurface structures and utilities

The Consultant will make all reasonable efforts prior to and during subsurface site investigations to minimize the risk of damaging any subsurface utilities/mains. If, in the unlikely event that damage is incurred where utilities were unmarked and/or undetected, the Consultant will not be held responsible for damages to the site or surrounding areas, utilities/mains or drilling equipment or the cost of any repairs.

The total amount of all claims the Client may have against the Consultant or any present or former partner, executive officer, director, stockholder or employee thereof under this engagement, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the amount of any professional liability insurance the Consultant may have available for such claims.

No claim may be brought against the Consultant in contract or tort more than two (2) years after the date of discovery of such defect.

DOCUMENTS AND REPORTING

All of the documents prepared by the Consultant or on behalf of the Consultant in connection with the Project are instruments of service for the execution of the Project. The Consultant retains the property and copyright in these documents, whether the Project is executed or not. These documents may not be used on any other project without the prior written agreement of the Consultant.

The documents have been prepared specifically for the Project, and are applicable only in the case where there has been no physical alteration to, or deviation from any of the information provided to the Consultant by the Client or agents of the Client. The Client may, in light of such alterations or deviations, request that the Consultant review and revise these documents.

The identification and classification as to the extent, properties or type of soils or other materials at the Project site has been based upon investigation and interpretation consistent with the accepted standard of care in the engineering consulting practice in the location where the Services were performed. Due to the nature of geotechnical engineering, there is an inherent risk that some conditions will not be detected at the Project site, and that actual subsurface conditions may vary considerably from investigation points. The Client must be aware of, and accept this risk, as must any other party making use of any documents prepared by the Consultant regarding the Project.

Any conclusions and recommendations provided within any document prepared by the Consultant for the Client has been based on the investigative information undertaken by the Consultant, and any additional information provided to the Consultant by the Client or agents of the Client. The Consultant accepts no responsibility for any associated deficiency or inaccuracy as the result of a miss-statement or receipt of fraudulent information.

JOBSITE SAFETY AND CONTROL

The Client acknowledges that control of the jobsite lies solely with the Client, his agents or contractors. The presence of the Consultant's personnel on the site does not relieve the Client, his agents or contractors from their responsibilities for site safety. Accordingly, the Client must endeavor to inform the Consultant of all hazardous or otherwise dangerous conditions at the Project site of which the Client is aware.

The client must acknowledge that during the course of a geotechnical investigation, it is possible that a previously unknown hazard may be discovered. In this event, the Client recognizes that such a hazard may result in the necessity to undertake procedures which ensure the safety and protection of personnel and/or the environment. The Client shall be responsible for payment of any additional expenses incurred as a result of such discoveries, and recognizes that under certain circumstances, discovery of hazardous conditions or elements requires that regulatory agencies must be informed. The Client shall not bring about any action or dispute against the Consultant as a result of such notification.

FIELD SERVICES

Where applicable, field services recommended for the Project are the minimum necessary, in the sole discretion of the Consultant, to observe whether the work or a contractor retained by the Client is being carried out in general conformity with the intent of the Services. Any reduction from the level of services recommended will result in the Consultant providing qualified certifications for the work.

DISPUTE RESOLUTION

If requested in writing by either the Client or the Consultant, the Client and the Consultant shall attempt to resolve any dispute between them arising out of or in connection with this Agreement by entering into structured non-binding negotiations with the assistance of a mediator on a without prejudice basis. The mediator shall be appointed by agreement of the parties. If a dispute cannot be settled within a period of thirty (30) calendar days with the mediator, the dispute shall be referred to and finally resolved by arbitration under the rules of the arbitrator appointed by agreement of the parties or by reference to a Judge of the British Columbia Court.

CONFIDENTIALITY

During the period of this Agreement, the Consultant shall not use or disclose any Confidential Information to any third parties. The Consultant will only use Confidential Information for the sole purpose of carrying out the service(s) agreed upon. Access to the Client's Confidential Information will be restricted to employees who need the information to perform work duties. The Consultant may share photos of the project without disclosing any information not already made public unless the Client refuses consent of photos shared on social media. Unless already made public, the Consultant will not share owner or site address information on social media or with outside parties.

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 48.650N 123.448W

2019-09-07 19:18 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.667	0.478	0.351	0.158
Sa (0.1)	1.019	0.737	0.539	0.242
Sa (0.2)	1.232	0.894	0.661	0.296
Sa (0.3)	1.243	0.902	0.665	0.293
Sa (0.5)	1.109	0.795	0.575	0.241
Sa (1.0)	0.641	0.436	0.301	0.114
Sa (2.0)	0.378	0.249	0.166	0.059
Sa (5.0)	0.118	0.068	0.037	0.012
Sa (10.0)	0.041	0.023	0.012	0.004
PGA (g)	0.545	0.395	0.291	0.128
PGV (m/s)	0.801	0.549	0.382	0.145

Notes: Spectral ($S_a(T)$, where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information



Natural Resources
Canada

Ressources naturelles
Canada

Canada



Canadian
Construction
Association

COVID-19 - Standardized Protocols for All Canadian Construction Sites

Version 4
April 16, 2020

For inquiries: Contact Zack Mullins
at zmullins@cca-acc.com

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COVID-19 - STANDARDIZED PROTOCOLS FOR ALL CANADIAN CONSTRUCTION SITES

The Standardized Protocols for All Canadian Construction Sites outlines the best practices for construction sites in order to maintain the health and safety of all workers required to perform duties during the COVID-19 crisis. The protocols, which include prevention, detection and response measures, will minimize the impacts of the crisis and ensure business continuity in the construction industry. This is not a legal document. Some provinces and municipalities have implemented stricter measures than those found in this document, and contractors are responsible for compliance with the rules, regulations and practices required by the applicable authorities. At the end of this document, there are links to information from some of our partner associations and other industry stakeholders that are further tailored to province specific requirements.

The objectives of the Standardized Protocols are to:

- Prioritize the health and safety of workers and of their surrounding communities;
- Apply recommendations and best practices from federal, provincial, and municipal public health authorities to construction site procedures;
- Establish and maintain a common COVID-19 Pandemic Response Plan across construction sites; and
- Foster open communication amongst stakeholders and ensure a respectful work environment.

Standardized Protocols for All Canadian Construction Sites

Prevention measures

Communication and awareness

- Clear signage is posted at entry points on the construction site and outline the commitment of the contractor to maintain health and safety measures during the COVID-19 crisis, with relevant updates from appropriate jurisdictions' public health authorities and self-identification screening tools.
- Worksite policies as they relate to the COVID-19 crisis are communicated to workers and made available on site.
- All workers exercise the following recommended practices for reducing the risk of transmission as identified by the Public Health Agency of Canada (PHAC), Health Canada, and Centers for Disease Control and Prevention:
 - o Avoid touching eyes, nose and mouth with unwashed hands;
 - o When coughing or sneezing:
 - Cough or sneeze into a tissue or the bend of your arm, not your hand;
 - Dispose of any tissues you have used as soon as possible in a lined waste basket and wash your hands afterwards;
 - o Non-medical face-coverings (such as homemade cloth masks) should be worn as a potential mitigant to catching and transmitting the virus, but are not to be treated as substitutes for proper handwashing, physical distancing, and other protective measures. Face-coverings should be created and used in line with



the guidelines provided by PHAC, found here: canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks/instructions-sew-no-sew-cloth-face-covering.html;

- o Clean and disinfect frequently touched objects and surfaces, including all reusable personal protective equipment (PPE);
- o Do not share personal items or supplies such as phones, pens, notebooks, tools, PPE, etc.;
- o Use and remove PPE with care, being mindful of which surfaces may be contaminated. Individuals must clean their hands after handling any used PPE;
- o Avoid common physical greetings, such as handshakes;
- o Maintain a minimum physical distance of two metres from others; and
- o Wash hands often with soap and water for at least 20 seconds after using the washroom, before handling food, after blowing nose, coughing, or sneezing, and before smoking. If hands are not visibly soiled, and soap and water are unavailable, alcohol-based hand sanitizer can be used.

Business-related travel

- Non-essential business travel is not authorized. Business travel is limited and on an exceptional basis only.
- All individuals returning from out of country must undergo a 14-day self-isolation period, as mandated by the federal government and outlined here: canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/latest-travel-health-advice.html.
- As some provincial governments impose similar restrictions for inter-provincial travel, any such requirements for self-isolation must be obeyed as applicable.

Working remotely

- Where practical, all office employees supporting a project work remotely. Meetings are held through teleconferencing or videoconferencing.

Access and movement to/from construction site

- Wherever possible, workers travel to site using individual modes of transportation (e.g., personal vehicle or bicycle). Additional parking arrangements are made as required.
- Entry and exiting of the worksite is monitored and controlled to ensure that the minimum physical distancing is not broken when shifts begin and end.
- All non-essential individuals are not permitted access to the site.

Monitoring the status of workers

- Detailed tracking of worker's status on-site and off-site are kept at all time (e.g. fit to work, sick, off-work for family caring duties, etc.). A list of all quarantined workers is updated daily, with their privacy maintained.
- Records are kept of which individuals work together and when.

Construction site and site trailer cleaning protocols

- All offices and jobsites implement additional cleaning measures of common areas. All door handles, railings, ladders, switches, controls, eating surfaces, shared tools and equipment, taps, toilets, and personal workstation areas are wiped down at least twice a day with a disinfectant, such as disinfectant wipes. Individuals are responsible for cleaning and disinfecting their workstations.



- Additional sanitary measures are implemented on site: hand washing stations with a posted hand washing protocol, hand sanitizer stations, provision of disinfectant wiping products. These types of facilities are made available at site entries, exits, washrooms, eating areas, offices, and any other areas with commonly touched surfaces.
- Commonly touched surfaces on vehicles and equipment are thoroughly cleaned and disinfected at the end of shifts and between users.
- All cleaning and disinfecting is carried out per PHAC's recommendations here: canada.ca/en/public-health/services/publications/diseases-conditions/cleaning-disinfecting-public-spaces.html.

Limiting and removing internal touch point areas

- Limit access and use of shared devices like coffee machines, water fountains, microwave ovens, and similar. Means to clean and disinfect such devices between uses is provided.
- Limit use of common pens for sign-in sheet to construction site.
- Washroom modifications - Install more sinks and sinks with physical separation between users where feasible. Change out taps, paper towel dispensers and garbage cans to hands-free models.
- Remove doors/door handles - Look at all reasonable opportunities to remove them.
- Where touch points like door handles and water coolers remain, paper towels are provided to allow users to avoid skin contact.
- Gloves are worn whenever possible while on the worksite, but are treated the same as bare hands in terms of minimizing unnecessary touching of anything on site and the user's face.

Compartmentalization

- The construction site is to be segregated to the extent possible in zones or other methods to keep different crews/trades physically separated at all time. This promotes physical distancing and supports the containment of propagation should it arise.
- Eating is restricted to clearly identified dedicated eating areas with handwashing stations, cleaning and disinfectant materials, and adequate space to maintain minimum physical distancing.
- Upper limits are put on the number of people allowed in each zone and in facilities like washrooms, trailers, and eating areas at once to allow for the recommended minimum physical distancing.
- One-way staircases are established wherever practical to minimize worker contact.
- Freight elevators are operated/occupied by only one individual at a time or where feasible, by respecting the minimum physical distancing guidelines.

Site operation

- The number of in person meetings is minimized. If required, meetings should involve only necessary individuals and include six people or fewer. Minimum physical distancing is maintained, and meetings are held in open spaces when possible.
- The worksite is rearranged to reduce high-traffic areas and allow for the minimum physical distancing.
- Site teams are encouraged to put forward split/alternating shifts to avoid extensive intermingling. Voluntary shift offset and implementing time gaps between shifts are highly encouraged.



- Alternate arrangements are made as necessary to ensure workers avoid breaking the minimum physical distance with others for prolonged periods. When this is not feasible, plans are made to minimize the duration of the task. For any work that ultimately must be done in close-proximity, a procedure is formalized outlining the required PPE and all steps to be taken to minimize risk.
- Where work is done in crews, the work is planned to minimize or eliminate the crossover of workers between crews.
- Project teams stagger break and lunch schedules to minimize the number of people in close proximity to one another. Enclosed lunchrooms are only made available during inclement weather.
- Work schedules are adjusted to provide time for proper cleaning and disinfecting as required.

Deliveries

- Delivery zones are clearly identified and limited to receivers and deliverers only.
- When possible, nothing is passed between the deliverer and the receiver (e.g. shipment documents and pens for signatures). Deliveries are unloaded solely by receivers using proper PPE, while deliverers remain in their vehicles.

Work in occupied spaces

- When working in spaces currently occupied (e.g. private residences), the minimum physical distancing with any occupants is strictly enforced. Where possible, workers and occupants are segregated in different rooms.
- Non-emergency work should not be done in any occupied spaces where an occupant is suspected to have contracted COVID-19 or is under self-isolation (per the directions of the applicable authorities). Emergency work can be carried out provided workers are equipped with nitrile gloves, Tyvek suits or coveralls, and facial/respiratory protection.
- Hands and tools are thoroughly cleaned before entering the workplace and after leaving, and any surfaces or equipment in the occupied space are disinfected before work is done on them.

Protocol auditing

- Contractors are to conduct periodic audits (frequency to be determined based on a project scale and scope) to verify that the appropriate measures have been implemented and are maintained.

Other

- Any other measures deemed to increase the safety or limit the propagation of the virus.

Detection measures

Screening at entry of construction site

- Before entering the site, individuals must confirm that:
 - They are not currently exhibiting flu-like symptoms such as fever, tiredness, coughing, or congestion;
 - They have not returned from outside of Canada within the past 14 days;
 - To the best of their knowledge, they have not been in contact with someone with a confirmed or probable case of COVID-19; and



- o They have not been working on a site that was shut down due to the virus.

Responses are to be kept private and treated as sensitive medical information.

- Individuals who are at increased risk of serious illness (due to age, pregnancy or other medical condition) are not to be permitted on site.
- Workers who are not authorized to access the site are to be safely transported directly back home, or to a preferred location of self-isolation. When unable to do so themselves, a vehicle and driver will be arranged for them.
- When transporting a potentially ill individual, both driver and passenger are to be given masks and nitrile gloves. The passenger is to sit in the backseat, and the driver is to open and close the doors for them.

Response measures

Possible cases of COVID-19

- Individuals who have been potentially exposed to the virus, or who are exhibiting flu-like symptoms such as fever, tiredness, coughing, or congestion are instructed to:
 - o Not come to work;
 - o Contact their supervisor and/or human resources department;
 - o Stay at home and self-isolate; and
 - o Contact local health authorities for further direction.

Such individuals are required to follow the directions of the local health authority and may not return to work until given approval by the proper health authorities.

- Individuals who begin to display flu-like symptoms on site are instructed to avoid touching anything, take extra care to contain coughs and sneezes, and return home immediately to undergo self-isolation as directed by the local health authority..
- All areas on site potentially infected by a confirmed or probable case are barricaded to keep individuals two metres away until the area is properly cleaned and disinfected.

Response plans

- All contractors are to complete an integrated continuity plan to respond to partial or complete shutdown of construction sites or in the case of a severe limitation of site operations.

Other

- Refer to canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19.html for the latest information.

The situation related to COVID-19 is changing rapidly. This Protocol will be updated on an as required basis to reflect the latest broadly adopted measures.



For province specific guidance, please review the resources linked below. Questions on province-specific health and safety matters can be directed to the listed contacts.

British Columbia

British Columbia Construction Association

bccassn.com/media/Guidance%20to%20Construction%20Sites%20Operating%20During%20COVID19.pdf

BC Construction Safety Alliance

Mike Mckenna, Executive Director mmckenna@bccsa.ca

Tammy Oliver, Senior Director toliver@bccsa.ca

Alberta

Alberta Construction Association

albertaconstruction.net/wp-content/uploads/2020/04/PANDEMIC-PLANNING-FOR-THE-CONSTRUCTION-INDUSTRY.pdf

Alberta Roadbuilders and Heavy Construction Association

279e5ecb-ae4a-4a97-bda5-1b2fe77f0894.filesusr.com/ugd/77f1bc_683524748e3c482aac8a8f59e5a86218.pdf?index=true

Alberta Construction Safety Association

Dan MacLennan, CEO dmaclennan@youracsa.ca

Tammy Hawkins, COO thawkins@youracsa.ca

Saskatchewan

Saskatchewan Construction Association

scaonline.ca/third-party-information-bulletins.html

Saskatchewan Construction Safety Association

Thomas Archer, VP of Operations thomasa@scsaonline.ca

Collin Pullar, President collinp@scsaonline.ca

Heavy Construction Safety Association of Saskatchewan

Al Goldstone, Safety Director alg@hcsas.sk.ca



Manitoba

Winnipeg Construction Association
togetherwebuild.ca/

Construction Safety Association of Manitoba

Sean Scott, Executive Director sean@constructionsafety.ca
Derek Pott, Director of Operations derek@constructionsafety.ca

Manitoba Heavy Construction Association

Don Hurst, Director don@mhca.mb.ca

Ontario

ORBA / OGCA / RESCON / OSPE / OHBA

orba.org/wp-content/uploads/2020/03/ORBA-branded-COVID19-resource-and-best-management-practices-document-Final.pdf

Infrastructure Health & Safety Association

Enzo Garritano, President egarritano@ihsa.ca
Paul Casey, Vice President pcasey@ihsa.ca

Quebec

L'Association de la construction du Québec

acq.org/coronavirus/sante-securite-du-travail/

ASP Construction

Sylvie L'Heureux, Executive Director slheureux@asp-construction.org

New Brunswick

New Brunswick Construction Association

nbcsa.ca/wp-content/uploads/2020/04/Construction-Site-COVID-19-Prevention-Procedures.pdf

New Brunswick Construction Safety Association

Roy Silliker, CEO rsilliker@nbcsa.ca
Shelley Poirier, Senior Safety Advisor spoirier@nbcsa.ca



Nova Scotia

Construction Association of Nova Scotia

cans.ns.ca/covid-19-managing-covid-19-on-the-worksite/

Construction Safety Association of Nova Scotia

MJ MacDonald, CEO

[mjadonald@constructionsafetyns.ca](mailto:mjmacdonald@constructionsafetyns.ca)

Damon Alcock, Chief Safety Officer

dalcock@constructionsafetyns.ca

Prince Edward Island

Construction Association of PEI

capei.ca/member_access/LiveEditor/images/Public%20Health%20Order%20-%20March%202020.pdf

Newfoundland and Labrador

Newfoundland and Labrador Construction Association

nlca.ca/critical-information-covid-19/

Newfoundland and Labrador Construction Safety Association

Jackie Manuel, CEO

jmanuel@nlcsa.com

Yukon

Northern Safety Network Yukon

Sheila Sergy, Executive Director

sheila@yukonsafety.com

Northwest Territories and Nunavut

Northern Construction Safety Association

Chris Johnston, Executive Director

chris@nsa-nt.ca



